# COMMON ROCKS AND ROCK MINERALS

Collier Cobb

Gift of the author

# Pocket Dictionary

of

# Common Rocks and Rock Minerals

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of North Carolina

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# PREFACE

This little book is intended for those college students of geology who have not at hand for immediate reference the more extensive works on petrology or mineralogy, or easy access to greater dictionaries and encyclopœdias. The terms defined relate only to the common rocks and rock minerals, such as are studied in the first two years of the college course, but are most of them omitted from our students' or collegiate dictionaries; and several of them that have already been used for nearly a decade are not yet in the largest dictionaries, though they have found a place in all our standard text books.

To the student who wishes to fill in some of the details of the mere outlines presented in this booklet, no better book can be recommended than,

ROCKS AND ROCK MINERALS. By Louis V. Pirsson, 1909. Many excellent illustrations from photographs, and 414 pages. New York: John Wiley and Sons.

He will also find especially useful A HANDBOOK OF ROCKS. By James Furman Kemp. 1911. New York: D. Van Nostrand Company.

Other books that will be consulted frequently by the more advanced student are "Quantitative Classification of Igneous Rocks," by Cross, Iddings, Pirsson, and Washington (1903), "Igneous Rocks," vol. i, (1909), vol. ii, (1913), "Rock Minerals," (1906), by J. P. Iddings, and "Natural History of the Igneous Rocks," by A. Harker, (1909).

The most suggestive book for the thoughtful student is "Igneous Rocks and their Origin," by R. A. Daly, (1914). New York: McGraw-Hill Book Company.

The tables have been in use by the writer for many years, undergoing constant revision.

COLLIER COBB.

Chapel Hill, N. C., September, 1914.

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## NOTE TO THE SECOND EDITION

The generous reception given the Pocket Dictionary has made it necessary to issue a new edition within a few months. No change has been made in the plan of the booklet, and but little in the text. Some errors have been corrected and a number of definitions added which the use of the little book has shown to be needed. In several instances the names of minerals by no means common in the country have been introduced because they are of economic importance in North Carolina, and the Dictionary was prepared primarily for my own pupils.

C. C.

March, 1915.

# DICTIONARY OF COMMON ROCKS AND ROCK MINERALS

**A-a** (Hawaiian). Jagged scoriaceous lava flows, as contrasted with pahoehoe. See *Lava.* Consisting of sand, earth, stones, and melted lava, cooled and broken up, formed by alternate haltings and onward movements of a lava-flow; contrasted with *pahoehoe,* a frozen lava-flow, which presents a smooth, satin-like surface.

**Accessory** minerals are not necessary to the definition of the rock but often determine its variety; as muscovite-granite.

**Acicular.** Needle-shaped, bristle-like, as some crystals of Bismuthimite.

**Acid** (Latin *acidus,* sour). Term applied in geology to igneous rocks containing a high percentage of silica. Containing a large amount of the acid element: as, the *acid* felspars, which contain 60% or more of silica. Also written *acidic.* See *salic.*

**Actinolite** (Greek *actis,* a ray, and *lithos,* stone). A radiated mineral consisting of silicates of calcium, magnesium, and iron. See *amphiboles.*

**Adobe** (Spanish). Alluvial and playa clays, in part eolian, of desert and arid regions, differing from ordinary clays of humid regions in containing carbonates and other soluble minerals. Used in the Southwest for making bricks that are used sundried and unburned.

**Æolian** (Gr. *Aiolos,* god of the winds). Deposits formed on land by the action of the wind. Now generally written *eolian.* Compare *subaerial.*

**Agglomerate.** A name for volcanic breccias, as distinguished from other breccias and from conglomerate.

**Aggrade.** To bring or tend to bring to a uniform grade or slope, by deposition of material. Streams aggrade their beds by depositing sediment. See *gradation.*

**Albertite.** See *hydro-carbons.*

**Albite** (L. *albus,* white). A soda felspar, white or nearly white.

**Algonkian** (named after a tribe of North American Indians). The geological system that includes the sedimentary rocks younger than the Archaean and older than the Palæozoic. See *Proterozoic.*

**Alkali.** Soluble mineral matter, other than common salt, contained in soils or natural waters.

**Alkali flat.** A sterile plain containing an excess of alkali, at the bottom of an undrained basin in an arid region; a playa.

**Alkali soil.** Any one of various soils found in arid and semi-arid regions, containing an unusual amount of soluble mineral salts which effloresce in the form of a powder or crust (usually white) in dry weather following rains or irrigation. The basis of these salts is usually soda with a smaller amount of potash, and usually a little lime and magnesia. Two main classes of alkali are commonly distinguished: *black alkali,* which may be any alkaline carbonate, but which practically consists of sodium carbonate (sal soda), which is highly corrosive and destructive to vegetation; and *white alkali,* characterized by the presence of sodium phosphate (Glauber's salt), which is less injurious to vegetation. Black alkali is so called because water containing it dissolves humus, forming a dark colored solution which, when it collects in puddles and evaporates, produces characteristic black spots.

**Alluvium** (L. *alluvium,* washed upon). Loose gravel, sand, and mud.

**Alum-shales.** Shales charged with alum, which in favorable localities may be bleached out and crystallized. The alum is the result of the decomposition of pyrite; the sulphuric acid thus produced, reacting on the alumina present, yields a double sulphate that is alum.

**Amber.** A yellowish translucent resin resembling copal, found as a fossil in alluvial soils, with beds of lignite, or on the seashore in many places, especially along the Prussian shore of the Baltic Sea. It takes a fine polish, and is uused for pipe mouthpieces, beads, etc., and as a basis for a fine varnish. By friction it becomes strongly electric.

**Amorphous** (Gr. *a,* priv., and *morphe,* form). Uncrystallized; without crystalline structure, both externally and internally. Perfect and distinct crystals are the rare exception, most mineral specimens being simply aggregates of mineral matter. In such cases, when the mineral is amorphous, the *structure* of the mass may be *columnar* or *fibrous; lamellar, foliaceous,* or *micaceous; granular, impalpable, compact,* or *massive.* And the *external form* of the mass may be *botryoidal* or *mammillary, stalactitic, amygdaloidal* or *concretionary, dendritic* or *arborescent.*

**Amphiboles** (L. *amphibolum,* ambiguous, from the variable nature of the mineral). A name given by Hauy to hornblende, from its resemblance to augite, for which it may readily be mistaken. Now applied to a group of minerals important as constituents of many rocks. Most of the series contain iron and magnesium. Hornblende is the typical species.

**Amygdaloid** (Gr. *amugdale,* almond). A cellular lava, whose cavities, caused by expanding steam-bubbles, are lined or filled with secondary minerals, as quartz, calcite, or the zeolites.

**Anatase** (Gr. *anatasis,* extension). A titanium dioxide; octahedrite; see *rutile.*

**Andalusite** (first discovered in Andalusia). A mineral of a gray, green, bluish, flesh, or rose-red color, consisting of anhydrous silicate of aluminium, sometimes found crystallized in four-sided rhombic prisms.

**Andesite** (named for the Andes, where it is abundant). A volcanic rock consisting essentially of a mixture of triclinic felspar with either hornblende or augite. Abundant in Cordilleran region.

**Anorthite** (Gr. *an,* priv., *orthos,* straight). A triclinic lime felspar, found in small transparent crystals on Mount Vesuvius, and existing also as a constituent mineral of some rocks.

**Anorthosite** (Gr. *an,* priv., and *orthos,* straight). A granular igneous rock composed almost exclusively of a soda-lime felspar, usually labradorite.

**Anorthoclase.** A felspar closely related to orthoclase, but triclinic. It is chiefly a silicate of sodium, potassium, and aluminium.

**Anthracite** (Gr. *anthrax,* coal). A hard, compact variety of mineral coal, with a bright, submetallic, iron-

black luster, conchoidal fracture, and a very small amount of volatile matter; hard coal. It consists of nearly pure carbon, and burns almost without flame. It is formed from bituminous coal by contact metamorphism and by dynamic metamorphism attending mountain-building.

**Anticline** (Gr. *anti,* on opposite sides, and *klino,* I bend). An archlike fold of stratified rocks, inclining in opposite directions from an axis.

**Apatite** (Gr. *apate,* deceit, and *lithos,* stone, apatite having often been mistaken for other minerals). Calcium phosphate with flourine, or sometimes chlorine, generally crystallized in hexagonal prisms. It varies in color from white to green or blue, rarely to yellow or reddish.

**Aragonite** (first found in Aragon, a division of Spain). Calcium carbonate crystallizing in the orthorhombic system, with a specific gravity of 2.93. See *calcite.*

**Archæan** (Gr. *archaios,* ancient). The earliest subdivision of Eozoic rocks.

**Archeozoic.** The era including the remotest geological time; the archæan.

**Arenaceous** (L. *arena,* a sand grain). Composed of sand grains. See *psammitic* and *psephitic.*

**Argillaceous** (Gr. *argillos,* clay; L. *argilla*). Composed of clay, *q. v.* See *pelitic.*

**Argillite.** An argillaceous rock breaking usually into thin and even slabs. Used in the manufacture of billiard tables, sinks, and burial vaults, and also as roofing slates.

**Arkose** (Fr.). A sandstone containing felspar; a fragmental rock formed of crystals of disintegrated granite.

**Arsenopyrite.** A mineral of a tin-white color and metallic luster, containing arsenic, sulphur, and iron; also called *arsenical pyrites* and *mispickel.*

**Arthropods** (Gr. *arthron,* a joint, and *podes,* feet). Invertebrate animals with jointed legs, as insects, spiders, and crabs.

**Asbestus.** A variety of amphibole or of pyroxene, occurring in long and delicate fibers, or in fibrous masses or seams, usually of a white, gray, or greenish gray color. The name is also given to a similar variety of

serpentine (chrysotile). Used for making an incombustible cloth, for lampwicks, and for fireproofing.

**Assimilation.** Rock magmas, forcing their way through solid rocks, may, through fusion of included fragments or wall rock, absorb or assimilate a certain amount of these foreign materials, thus changing in some degree the chemical composition of the magma as a whole. This is called assimilation.

**Atmogenic.** Used by Grabau of rocks due to the work of the atmosphere; æolian rocks and those due to atmospheric weathering.

**Atmosphere.** The gaseous enevolpe that surrounds the earth and extends to an undetermined height above its surface; the air. A mechanical mixture of 79 parts, by volume, of nitrogen and 21 oxygen, with nearly one per cent of argon, a trace of carbon-dioxide, and a variable quantity of water-vapor, ammonia, ozone, and organic matter. See *Hydrosphere* and *Lithosphere.*

**Augen** (Ger., eyes). Used as a prefix before various rock names, but more especially gneiss, to describe larger minerals or aggregates of minerals, which are in contrast with the rest of the rock.

**Augite** (Gr. *auge,* lustre). A greenish or brownish-black aluminous pyroxene, occurring mostly in eruptive rocks, as basalt. The commonest mineral species belonging to the group of pyroxenes. Compare with *hornblende.*

**Autogenetic.** Self-determined; as, *a. drainage,* a system of natural drainage developed by the constituent streams through headwater erosion; and, *a. topography,* a system of land forms produced by the free action of rain and streams on rocks of uniform texture.

**Barilla.** An impure sodium carbonate and sulphate obtained by burning various species of land or marine plants, as the glasswort, seaweed, etc., especially in Spain, in the Levant, and along the Bay of Biscay, used for making glass, soap, etc.; name applied to several different plants used for making soda-ash; grains of native copper occurring in ore.

**Barite** (Gr. *barus,* heavy). A heavy, vitreous, usually white, transparent to opaque barium sulphate ($BaSO_4$) crystallizing in the orthorhombic system. It is often found associated with metallic ores, as lead.

**Barysphere** (Gr. *barus,* heavy, and *sphaira,* sphere). The heavy core of the earth; the centrosphere. The materials composing the core of the earth are more than twice as heavy as those composing the lithosphere.

**Basalt** (word of African origin). Basic lava or dyke rock.

**Basanite** (Gr. *basanos,* a dark stone used as a touchstone for gold). First used for basalt. A volcanic rock of felsitic or finely-porphyritic texture, consisting of plagioclase, augite, olivine, and nepheline or leucite, one or both; a soda-rich basic volcanic rock.

**Base** (Gr. *basis,* foundation). A material that combines with an acid without losing anything.

**Basic.** This term is applied in geology to igneous rocks rich in bases and containing a comparatively small proportion of silica. See *femic.*

**Batholith** (Gr. *bathos,* depth, and *lithos,* stone). A large, irregular stock-like mass of intrusive igneous rock, that has crystallized at great depth, and is now exposed by erosion. Name suggested by Suess.

**Bauxite** (named for Baux, France). A white to red, round, concretionary, earthy, or clay-like aluminium iron hydroxide; the principal source of the metal aluminium.

**Beryl.** A mineral of great hardness (8), occurring in hexagonal prisms, commonly of a green or bluish green color, but also yellow, pink, and colorless to white. It is a silicate of aluminium and glucinum (beryllium). The *aquamarine* is a transparent sea-green variety used as a gem. The *emerald-beryl* is another variety highly prized in jewelry, and distinguished by its deep-green color, which is probably due to the presence of a little oxide of chromium.

**Biotite** (Biot, a French physicist). A pearly to submetallic, brown to green or black, magnesium-iron-mica of monoclinic crystallization. See *mica.*

**Bitumens.** See *hydro-carbons.*

**Bituminous Coal.** Is comparatively brittle, of deep-black color, and often cubical fracture. When heated, it emits a considerable amount of volatile matter, and burns like bitumen, with a yellow smoky flame; soft coal. Bituminous coals are called *coking* when used for the production of coke, *furnace* when suitable for

use in a furnace, and *cannel,* or *jet,* when rich in gas, with low heating power.

**Bituminous-shale.** Shale containing hydrocarbons or bituminous material; when rich in such substances yielding oil or gas on distillation, and called *pyroschist* or *oil-shale; resiniferous shale,* or *tasmanite,* is a resinous, reddish-brown, translucent hydrocarbon derivative found in certain laminated shales of Tasmania.

**Blackband.** Black, bituminous carbonate of iron, often interbedded with coal, and valuable as an iron ore.

**Boss.** A dome-like mass of plutonic rock, which, because of great resistance to erosion, is left standing above the surrounding country.

**Botryoidal** (Gr. *botrus,* cluster). Having grape-like surfaces. When the rounded prominences are larger, the form is called *mammillary, q. v.*

**Boulder-clay.** Unsorted glacial deposits consisting of sub-angular scratched stones (boulders) and clay.

**Brachiopods** (Gr. *brachion,* arm, and *podes,* feet). A class of marine invertebrate animals with a shell composed of two valves; the body has a number of arm-like processes. See *lamellibranch.*

**Bradyseism** (Gr. *bradus,* slow, and *seismos,* earthquake). A broad gentle curving of the surface upward or downward; an upwarp or downwarp.

**Breccia** (Italian, a breach in a wall). Rock composed of coarse angular fragments.

**Bronzite.** A magnesium metasilicate containing iron, occurring massive and in orthorhombic crystals.

**Bryozoa** (Gr. *bruona,* mossy, and *zoon,* a living being). A class of lowly compound animals usually growing in tufts or thin sheets.

**Bysmalith** (Gr. *bysma,* plug, and *lithos,* stone). A plug-like mass of igneous rock forced vertically into overlying strata, forming in them a dome-like uplift often accompanied by faulting. Name suggested by Iddings.

**Cainozoic** (Gr. *kainos,* recent, and *zoe,* life). The period of recent life. The name of the last of the five geological eras. Usually spelled Cenozoic.

**Calcareous** (L. adj. *calcarius,* from *calx,* lime). Composed of carbonate of lime.

**Calcite** (L. *calx,* lime). A calcium carbonate, usually

colorless or whitish, crystallizing in the hexagonal system. See *Iceland spar.*

**Cassel-brown** (Kassel, Germany). A brown pigment of varying permanence, consisting of impure lignite.

**Cassiterite** (Gr. *kassiteros,* tin). Native tin dioxide, a mineral crystallizing in tetragonal forms, usually brown to black, and having splendent adamantine luster on the crystalline faces. According to its appearance it is called tin-stone, needle-tin ore, wood-tin, toad's-eye tin, and stream-tin. See *greisen.*

**Celestite.** Native strontium sulphate, a mineral so named from its occasional delicate blue color. It crystallizes in the orthorhombic system, and also occurs massive, fibrous, etc.

**Cenozoic.** The form preferred in America. See *Cainozoic.*

**Chalcedony** (named for Chalcedon, an ancient city of Asia Minor, opposite Byzanteum; now Kadikoe). A waxy, transparent or translucent, crypto-crystalline quartz, in fibrous and often mammillated forms. *Flint* or *chert* is a concretionary form in which some interstitial opal may be present.

**Chalk.** A marine, calcareous and excessively fine, organic sediment, usually consolidated. "*Chalk* is but the dried mud of an ancient sea, the cemetery of countless animalcules that lived and died long ago."

**Chalcopyrite** (Gr. *chalkos,* brass; *pyr,* fire). A mineral containing copper, iron, and sulphur, occurring massive and in tetragonal crystals of a bright brass-yellow color; a common ore of copper.

**Chalcocite** (Gr. *chalkos,* brass). Native copper sulphide; a mineral of a black color and metallic luster.

**Chert** (Old Irish *caert,* a pebble). A dull-colored, subtranslucent, somewhat brittle impure variety of chalcedony; name applied to flint concretions in the older rocks.

**Chlorite** (Gr. *chloritis,* greenstone). Hydrous aluminium magnesium iron silicates, resembling green micas, but softer and with non-elastic plates; a secondary mineral closely related to the micas.

**Chonolith** (Gr. *choanos,* a melting-pot; *chonos,* a mold used in casting metal and *lithos,* stone). Name coined by Daly to describe "an igneous body (*a*) injected into dislocated rocks of any kind, stratified or

not; (*b*) of shape and relations irregular in the sense that they are not those of a true dike, vein, sheet, laccolith, bysmalith or neck; and (*c*) composed of magma either passively squeezed into a subterranean orogenic chamber, or actually forcing apart the country-rocks." In this last case it cannot differ clearly from a laccolith (see *laccolite*) which has gradually made a place for itself by the process which Daly calls magmatic stoping.

**Chromite** (Gr. *chroma*, color). Iron chromium oxide ($FeCr_2O_4$) that crystallizes in the isometric system. Magnesium may replace part of the dyad iron, and aluminium and triad iron some of the chromium.

**Chrysotile.** A silky, green to yellowish green, delicately fibrouus, flexible and sectile, hydrated silicate of magnesium (*asbestus, q. v.*), occurring in fibrous veins in serpentine.

**Cinnibar.** Red sulphide of mercury, occurring in brilliant red crystals, and also in red or brown amorphous masses. Used in medicine and as a source of mercury. An artificial red surphide of mercury is used as a pigment; vermilion.

**Clastic** (Gr. *klastos*, broken to pieces). Sedimentary rocks composed of fragments.

**Clay** (Anglo-Saxon). Common earth of various colors and fine grain, compact and brittle when dry, but plastic and tenaceous when wet. It is a hydrous aluminium silicate, generally mixed with powdered felspar, quartz, sand, iron-oxide, and various other minerals, and is formed from the decomposition of aluminous rocks, chiefly granites and gneisses. Soil the diameter of whose constituent grains is .005—0 mm.

**Cleavage** (Gr. *clao*, to break in pieces). The property by which some minerals break with smooth flat surfaces. A secondary structure developed in rocks by pressure, often accompanied by recrystallization, and characterized by a tendency to split along definite planes which may be highly inclined to the original bedding.

**Coals.** Brittle, compact, massive, amorphous, and sometimes laminated mineral substances, brown to black in color, derived from vegetation in different geological ages, containing different hydrocarbons, with sometimes free carbon, and also complex substances carrying oxygen and nitrogen, found in beds in the earth and used as fuel. The coals pass from *peat,*

through lignite and bituminous coal, to anthracite or hard coal, and even into graphite by a high degree of metamorphism.

**Coelenterata** (Gr. *koiloma,* hollow, and *entera,* entrails, guts). The group of multicellular animals in which there is no digestive cavity separated from a distinct body cavity.

**Coelomata** (Gr. *koiloma,* a hollow cavity). A group of multicellular animals in which there is a digestive tube distinct from the body cavity.

**Concretion** (L. *concretio,* grow together). An aggregation of mineral matter, usually calcareous or silicious, in concentric layers, so arranged as to give rise to a form approaching the spherical, but often much flattened. "The deposition generally begins upon some nucleus, such as a grain of sand, a leaf, a shell, or even a small fossil fish. Concretions are common in sandstones, shales, and clays."

**Conglomerate** (Lat. *conglomero,* I roll together). A rock composed of rounded pebbles.

**Coprolite** (Gr. *kopros,* dung). The petrified or fossil dung of extinct vertebrates, in some localities forming a phosphate rock which is mined for a fertilizer.

**Coquina** (Spanish). A soft rock composed of fragments of marine shells; used in Florida as a building material.

**Corundum** (Hind. *kurand*). An extremely hard, usually variously-colored aluminium oxide ($Al_2O_3$) used for grinding and polishing. It crystallizes in the hexagonal system and also occurs massive and granular. In hardness it is next to diamond (9) and its sp. gr. is about 4. In color it is blue, red, yellow, brown-gray, and white. The transparent varieties are prized as gems, the blue being the sapphire, the violet the Oriental amethyst, the red the ruby, and the yellow the Oriental topaz. *Emery* is granulated corundum, more or less impure, generally containing magnetic iron. The best corundum gems come from Burma, India, China, and Ceylon, though they are also found in North Carolina, and sapphires in Montana; common corundum comes from China, the Urals, Canada, N. J., Pa., N. C., S. C., and Georgia; emery from Asia Minor, the islands of Naxos and Samos, from Chester, Mass., and Peekskill, N. Y.

**Crinoid** (Gr. *krinon,* a lily, and *eidos,* likeness). A sea lily. Crinoidea are a class of Echinoderms.

**Cryolite** (Gr. *kruos,* icy cold). A fluoride of sodium and aluminium, found in Greenland in white cleavable masses; used as a source of soda and alumina.

**Crystalline** (Gr. *krustallos,* ice). Composed of crystals.

**Crystallization.** The process of forming crystals. There are six systems of crystallization, based on the kind of symmetry possessed by the crystals, or upon the manner in which the faces of the crystals are related to certain imaginary fixed lines, having definite direction and relative length, in the crystal. The systems are known as:

I. *Isometric,* monometric, regular, cubic, tesseral, or tessular: having three equal axes, all crossing at right angles; example, the cube, the tetrahedron.

II. *Tetragonal,* dimetric, quadratic, pyramidal, or quaternary: two axes equal, third unequal, all crossing at right angles; example, a square prism.

III. *Hexagonal* or rhombohedral: three equal axes lying in one plane and intersecting at angles of 60°, and a fourth axis crossing these at right angles, and longer or shorter; example, hexagonal prism.

IV. *Orthorhombic,* orthsymmetric, trimetric, rhombic, or prismatic: three unequal axes, but all interesections at right angles; example, rhombic prism.

V. *Monoclinic,* monosymmetric, clinorhombic, or oblique: three unequal axes, one intersection oblique; example, oblique rhombic prism.

VI. *Triclinic,* asymmetric, clinorhomboidal, anorthic, or doubly oblique: three unequal axes, all crossing obliquely; example, oblique rhomboidal prism.

**Crystallization, Order of.** The order of crystallization of a coarse-grained igneous rock is easily made out when studied on a polished surface with a lens, the enclosed crystals being evidently older than those enclosing them. First are the oxides or ores of iron, then ferromagnesian minerals, then soda-lime felspars, then alkalic felspars and felspathoids, and lastly quartz.

**Degrade.** To reduce the height of (any part of the earth's surface) by the wearing action of natural agents, as by river action. *Degraded,* worn down or

away by erosional processes, especially by stream erosion. See *gradation.*

**Dendritic** (Gr. *dendron,* tree). Tree-like; branching or arborescent in form. *Dendrite,* a stone or mineral on or in which are figures resembling trees, shrubs, or mosses.

**Desert-varnish.** A peculiar polish produced on hard rocks and stones by the action of wind-blown sand. This is by no means confined to desert regions, some of the best known examples being from Rock Co., Minnesota, central Wisconsin, and other portions of the Lake Superior region, where the winters are dry and cold and windy.

**Detritus** (L., worn). Loose fragments or particles of rock, whether angular or water-worn, but especially the latter.

The Bureau of Soils uses the following classification of detrital materials:

| *Name of Material* | *Diameter in Millimeters* |
|---|---|
| Fine Gravel | 2-1 |
| Coarse Sand | 1-0.5 |
| Medium Sand | 0.5-0.25 |
| Fine Sand | 0.25-0.1 |
| Very Fine Sand | 0.1-0.05 |
| Silt | 0.05-0.01 |
| Fine Silt | 0.01-0.005 |
| Clay | 0.005-0.0001 |

**Devitrification.** The conversion of glassy to crystalline or lithoidal texture by slow crystallization after solidification in igneous rocks.

**Diabase** (Gr. *diabasis,* a crossing-over). A granular igneous rock, in many places porphyritic, composed essentially of plagioclase, ordinarily labradorite, augite, and magnetite, with or without olivine, and characterized by the felspar having crystallized before the augite. It includes most trap.

**Diallage** (Gr. *diallage,* interchange). A brown, gray, or green thin-foliated variety of pyroxene, crystallizing in the monoclinic system; an altered augite with a shimmery submetallic lustre.

**Diatoms** (Gr. *dia,* through, and *tome,* a cut). A group of minute aquatic plants with siliceous shells, each of two valves.

**Differentiation.** The process of the separation of a homogeneous igneous rock magma, while molten, into portions which form rocks physically or chemically unlike.

**Dike** (Middle English, akin to our modern word *ditch*). A long and relatively narrow body of igneous rock, which in a state of fusion has forced its way into a fissure in older rocks and there chilled and solidified. Compare with *vein*. See *Igneous rocks*.

**Diopside** (Gr. *diopsis*, view through). A grayish-white or grayish-green readily cleavable variety of pyroxene.

**Diorite** (Gr. *dioros*, a well-marked distinction). The typical plutonic rock of the sub-basic group composed essentially of plagioclase, commonly andesine, and hornblende or biotite.

**Dip.** A stratum's angle of inclination to the horizon, or that of a line perpendicular to its direction or *strike*.

**Dissemination** of ore deposits is seen in the impregnation (along certain bands) of schistose rocks with finely divided sulphides—the *fahlbands* of the Germans, sometimes as a filling of open spaces, or as a replacement of certain minerals. Such forms of ore bodies are frequently rich enough to work.

**Dolerite** (Gr. *doleros*, deceptive, and *lithos*, stone). The basic igneous rock less coarse-grained than gabbro; a coarsely crystalline variety of basalt; sometimes used interchangeably with *diabase*.

**Dolomite** (named after a French mineralogist, Dolomieu). The mineral species or rock composed of approximately equal amounts of carbonate of lime and carbonate of magnesia.

**Dolomitization.** A process by which massive deposits of ordinary limestone have been more or less altered to dolomite by the action of magnesium vapors, or magnesium salts in solution. "If the $MgCO_3$ approximates the 45.65% of the mineral dolomite, there is great shrinkage in bulk, leading to the development of porosity and cavities up to 11% of the original rock."

**Dreikanter.** Pebbles whose sub-angular and polyhedral shapes are due to cutting by wind-blown sand. *Dreikanterite*, a rock composed of such pebbles cemented together, is sometimes mistaken for tillite.

**Dunite** (Dun Mountain, near Nelson, New Zealand). An ultra-basic intrusive rock consisting essentially of a crystalline granular mass of olivine with chromite or picotite, containing frequently more or less of various other minerals. Dunite is frequently more or less altered into serpentine.

**Dyke.** See *dike*, which is the preferred spelling.

**Echinoderms** (Gr. *echinos*, the hedge-hog, and *derma*, skin). A group of coelomate animals with spine-bearing skin or shell, the sea-urchins, sea-cucumbers, star-fish, etc.

**Ejecta** (L., neut. pl. of *ejectus*, cast out). Material thrown out; as, the *ejecta* of a volcano.

**Element.** One of the ultimate forms of matter that cannot be decomposed by any means known to science. Seventy-two such substances are now recognized. Nearly all of them known on the earth are found in the igneous rocks, though but few of them are abundant. The few that may be regarded as the normal or essential constituents of rocks are given in the following table from Clarke:

| ELEMENT | SYMBOL | PER CENT IN THE SOLID CRUST |
|---|---|---|
| Oxygen | (O) | 47.02 |
| Silicon | (Si) | 28.06 |
| Aluminium | (Al) | 8.16 |
| Iron | (Fe) | 4.64 |
| Calcium | (Ca) | 3.50 |
| Magnesium | (Mg) | 2.62 |
| Sodium | (Na) | 2.63 |
| Potassium | (K) | 2.32 |
| Titanium | (Ti) | .41 |
| Hydrogen | (H) | .17 |
| Carbon | (C) | .12 |
| Phosphorus | (P) | .09 |
| Manganese | (Mn) | .07 |
| Sulphur | (S) | .07 |

It will be noticed that only eight of the elements exceed one per cent, and no other reaches one-half of one per cent.

**Endomorphic** effects are those produced by mineralizing vapors excluded from a magma as it cools and crystallizes, and collecting more and more in the outer margin at the contact. The granite of Harney's Peak, with its outer zone of pegmatite and abundant crystals of tourmaline, muscovite, green beryl, and red garnets,

illustrates this. A common phenomenon of contact metamorphism.

**Enstatite** (Gr. *enstatites,* adversary). A magnesian metasilicate, grayish-white to brown, occurring massive and in orthorhombic crystals. See *pyroxenes.*

**Eocene** (Gr. *eös,* the dawn). The dawn of recent life; the first system of the Cenozoic Era.

**Eözoic** (Gr. *eös,* the dawn, and *zoön,* a living being). The era of the dawn of life. The name of the oldest of the five geological eras. Of or pertaining to the upper portion of the Archæan series of rocks, immediately underlying the Palæozoic: embracing the Laurentian and Huronian periods.

**Eozoon.** An irregular cellular mass containing calcareous matter, occurring in the Laurentian rocks of Canada, Bohemia, Scandinavia, and other countries, and formerly regarded by some naturalists as a foraminifer related to the nummulities.

**Epidote** (Gr. *epididomi,* give besides). A calcium aluminium iron silicate, with monoclinic crystallization, yellowish-green (pistachio) to black. It is also found granular and fibrous. The epidote group includes zoisite, epidote, piedmontite, and allanite.

**Epigene.** Produced or occurring at the surface of the earth; as, *epigene* rocks; opposed to *hypogene.*

**Epigenetic** (Gr. *epi,* and genesis). Pertaining to a system of natural drainage originally established upon overlying terranes, but by their complete degradation transferred to inferior terranes; superimposed; as, *epigenetic* valleys. Also used in the sense of *metamorphic, q. v.* See *syngenetic.*

**Erosion.** The removal of loose material in suspension in moving water, or by the action of wind.

**Essential** minerals are those necessary to the definition of a rock species; as, quartz and orthoclase in granite. See *accessory.*

**Eutectic** (Gr. *eu,* well, and *tekein,* melt, fuse). Of maximum fusibility; *E. mixture,* a mixture that has the lowest melting point which it is possible to obtain by any combination of the given minerals or metals; *E. point,* the temperature at which the minerals in a rock magna solidify simultaneously. See *zonation, pegmatite.*

**Fault** (O. E.). A dislocation caused by a slipping of rock masses along a plane of fracture; also the dislocated structure resulting from such slipping.

The surface along which the dislocated masses have moved is called the *fault plane*. When this plane is vertical, the fault is a *vertical fault;* when its inclination is such that the present relative position of the two masses could have been produced by the sliding down, along the fault plane, of the mass on its upper side, the fault is a *normal,* or *gravity fault.* When the fault is so inclined that the mass on its upper side has moved up relatively, the fault is then called a *reverse* (or *reversed*), *thrust,* or *overthrust fault.* If no vertical displacement has resulted, the fault is then called a *horizontal fault.* The linear extent of the dislocation, measured on the fault plane and in the direction of the movement, is the *displacement;* the vertical displacement is the *throw;* the horizontal displacement is the *heave.* The direction of the line of intersection of the fault plane with a horizontal plane is the *trend* of the fault. A fault is a *strike fault* when its trend coincides approximately with the strike of associated strata; it is a *dip fault* when its trend is oblique to the strike. Oblique faults and dip faults are sometimes called *cross faults.* A series of closely associated parallel faults are sometimes called *step faults* and sometimes *distributive faults.*

**Feldspar.** This form of the word was used by Wallerius in 1747 for orthoclase, but is now commonly used as a group name; variant of *felspar,* q. v., used first by Kirwin in his Mineralogy, i. 317 (1794), and now the common English form.

**Felsite.** A cryptocrystalline mixture of quartz and felspar; the groundmass of the quartz-porphyries, and often the product of devitrification.

**Felsophyre.** A porphyritic rock with felspar phenochrysts.

**Felspars** (German *fels,* rock, or *feld,* field, and *spath,* a spar or mineral). A group of common rock-forming minerals, having in common a prismatic angle of about 120°, and consisting of aluminium silicate with potassium, or sodium, or calcium, or all of these, or sometimes barium. Members of the felspar family con-

stitute much the largest portion of the igneous rocks. *Orthoclase* is a potash felspar, *albite* a soda felspar, *anorthite* a lime felspar, *oligoclase* a soda-lime felspar, and *labradorite* a lime-soda felspar. Orthoclase and the corresponding sodium form, albite, lie at one end of the series, and the calcium felspar, anorthite, at the other. The orthoclase crystallizes in the monoclinic system; a triclinic form, microcline, is also common. All the other felspars are triclinic, and, with microcline, are often styled *plagioclase*. The principal felspars between alibte and anorthite are oligoclase and labradorite.

**Felspathoid** (from felspar, and Gr. *eidos,* likeness). A group of minerals that may replace the felspars in igneous rocks, as leucite, nephelite, sodalite, etc.; in general, silicates of aluminium and potassium or sodium, which act like the felspars in the formation of igneous rocks.

**Femic** (Fe, the symbol for iron, Latin *ferrum,* and M, for magnesium). A term applied to rocks containing much iron and magnesium, or the minerals such as hornblende, augite, biotite, and olivine, which are largely ferromagnesian silicates. See *salic.*

**Fire-clay.** A very refractory clay often found at the bottom of peat-bogs and in association with coal beds; used for making fire-bricks and crucibles.

**Flint** (Anglo-Saxon). A sub-vitreous dull-colored variety of quartz resembling chalcedony but more opaque, and when found in chalk consisting largely of the remains of diatoms and sponges. See *chalcedony.*

**Fluorite** (L. *fluo,* flow). Calcium fluoride, a mineral of many different colors, white, yellow, purple, green, red, etc., often very beautiful, crystallizing commonly in cubes with perfect octahedral cleavage; also massive. It is used as a flux. Some varieties are used for ornamental vessels. Also called *fluor spar.*

**Foliation** (L. *folium,* a leaf). The arrangement of the minerals in a crystalline rock in parallel layers.

**Foraminifera** (L. *foramen,* an opening, and *fero,* I bear). Microscopic unicellular animals that live in the sea; their shells are important constituents of many limestones.

**Formation.** Mineral deposits and rock masses named with reference to their origin; as, the siliceous *forma-*

*tion* about geysers; alluvial *formations;* marine *formations.* A group of beds of the same age or period; as, the Cretaceous *formation.* An assemblage of beds of a uniform or uniformly varying lithological character; as, the *Deep River formation,* the *Clinton formation.* When named for a locality the word formation is frequently omitted and the character of the rock indicated; as, the *Potsdam sandstone.* A *formation* is the unit used in geological mapping.

**Fossil** (L. *fossa,* a ditch). Any record of an organism preserved in the crust of the earth; as, the plant or animal itself or its shell or skeleton in whole or in part, an impression such as a track, a cast, or a replacement or petrifaction.

"Every fossil is more or less an index to the age of the rock in which it occurs, for it is a relic of the life which inhabited the earth when that sediment which now forms the enclosing rock was being deposited. It was early observed that succeeding rocks contain different fossils, that as they were followed from the lower to the higher beds, the inclosed fossils changed. At present the succession of life in general upon the earth is known, though more and more of its details are being discovered each year. It is known these successive faunas and floras follow each other in rocks the world over in approximately the same order." *Shimer.* The sequence of faunas was first determined, however, *by superposition of the strata.* The primary basis for correlation by means of fossils is, therefore, *stratigraphy, q. v.*

By means of fossils geologists are enabled to distinguish between *marine, freshwater,* and *terrestrial* deposits, *o. q. v.*

**Fracture.** The form or kind of surface obtained by breaking a mineral in a direction other than that of the cleavage. It is *conchoidal* when the surface is curved, *even* when the surface is nearly plane, *uneven* when the surface is rough and irregular, and *hackly* when the surface is sharp or jagged.

**Fragmental rocks** are formed from the fragments of preexisting rock, and may be of aqueous, eolian, or glacial origin. See *clastic* and *sedimentary.*

**Freshwater deposits** are very limited in area when com-

pared with marine deposits, just as lakes and estuaries are of small dimensions when compared with seas.

"The absence of many fossil forms usually met with in marine strata affords a useful negative indication of the freshwater origin of a formation. For example, there are no sea-urchins, nor corals, no chambered shells, such as the nautilus, no microscopic foraminifera in lacustrine or fluviatile deposits." *Lyell.* Only a small number of genera of bi-valve shells inhabit fresh water, and these all have two large muscular impressions in each valve, as the cyclas and unio. Such forms as the oyster and the scallop, on the other hand, have only one of these impressions. Now, as none of these last, or unimuscular bi-valves, is freshwater, we may at once presume a deposit containing any of them to be marine. See *Marine deposits* and *Terrestrial deposits.*

**Fulgurite** (L. *fulgur,* lightning). A little tube of glassy rock formed in sand by the passage of lightning; also found on exposed crags or mountain tops.

**Fuller's earth.** A non-plastic clay used in fulling cloth, and to remove grease.

**Fumarole.** A small hole from which volcanic gases issue. *Fumarolic,* due to the action of volcanic gases.

**Fusibility, Scale of.** An arrangement of minerals according to readiness in fusing: 1. stibnite; 2. natrolite; 3. almandine garnet; 4. actinolite; 5. orthoclase; 6. bronzite.

**Gabbro** (Italian). The typical basic plutonic rock, consisting essentially of pyroxene, usually augite or diallage, and plagioclase, commonly labradorite, ordinarily with magnetite, and in many varieties with olivine. Varieties with rhombic pyroxene are called norite.

**Galenite** (L. *galena,* lead ore). Lead sulphide; the principal ore of lead, of a bluish gray color and metallic luster, cubic in crystallization and cleavage.

**Gangue** (A-S *gangan*). The mineral substance which encloses a vein or is associated with a metallic ore. Quartz is the most abundant gangue mineral. See *veinstone.*

**Garnets** (L. *granum,* a seed). A series of vitreous to resinous, transparent to subtranslucent, red, brown, yellow, white, green, or black, brittle non-cleavable sili-

cates, crystallizing in the isometric system. The common red garnet in mica-schists is *almandine,* while that in altered limestones is *grossularite.*

**Geest.** Material derived from rock-decay *in situ.* Provincial word for earth in Holland and North Germany; and in use in the north central states of the U. S. for high gravelly land. Obsolescent. Compare *laterite, regolith, saprolite.*

**Geode** (Gr. *ge,* earth, *eidos,* form). A concretionary or nodular stone having a cavity lined with crystals.

**Geology** (Gr. *ge,* earth, and *logos,* discourse). "The history of the earth and its inhabitants, as revealed in its structure, and as interpreted by causes still in operation." *Le Conte.* "Geology is the history of the earth in precisely the same sense that Biology is the history of living beings." *Huxley.*

*Dynamical Geology* deals with the causes and proceses by which the structural features, changes, and conditions of the earth have been produced, of the forces that have been and are still at work upon and within the earth; *structural geology* has to do with the materials of the globe and their arrangement; *historical geology* investigates the history of the earth as regards its rocks, minerals, rivers, valleys, mountains, climates, and, especially the succession of life upon the globe. *Agrogeology* is geology in relation to soil fertility and crop production. *Anthropic g.,* the study of geological phenomena resulting from the presence or agency of man. *Areal g.,* the study of the areal distribution of formations, rocks, and minerals. *Astronomical g.,* the part of geology dealing with the earth as a planet. *Economic g.,* the study of the geological relations of useful minerals, as ores, building stones, etc.

**Geyserite.** Siliceous deposit from a geyser.

**Glauconite** (Gr. *glaukion,* juice of a poppy-like plant; *glaukos,* silvery, bluish-gray). An amorphous, olive-green, loosely-granular, massive hydrous iron potassium silicate, with some aluminium, magnesium, and calcium, formed in marine deposits. Greensand.

**Gneiss** (Ger.). A crystalline rock, of whatever origin, having the component minerals arranged in parallel bands or layers, and with a tendency to cleave into slabs. Formerly the name was applied to a banded rock composed essentially of quartz, felspar, and mica,

with or without other minerals, the term then implying a definite mineral composition as well as a characteristic structure. Gneisses shade imperceptibly into the massive crystalline rocks or the unaltered sediments on the one hand, and into schists on the other. They differ from schists in being banded or layered rather than schistose, and in the degree of fissility, but there is no sharp line between the two.

Gneisses are named from the rocks from which they were derived, as granitic gneiss, conglomerate gneiss, etc., and from some containing mineral, as feldspathic, hornblendic, epidotic, and graphitic gneiss, and many other varieties.

Most gneisses are metamorphic rocks, the banded or layered structure being due to re-arrangement and segregation of the minerals, perhaps with recrystallization while the rock was in a highly plastic condition as the result of heat and pressure. There may have been some flow of the rock material as well. Other gneisses owe their banding in part to the original banding of the rock, and primary gneisses, in which the banding is a true flow structure, formed while the rock was still molten, are also known.

Augen- or eye-gneiss contains large crystals or lenticular lumps (eyes) commonly of felspar though sometimes flattened quartz pebbles, imbedded in the fine-grained and more schistose matrix. The longer diameters of the augen or lenses are parallel to the banding of the rock, and the foliation of the finer matrix divides around them so as to increase the resemblance to eyes. Fundamental gneiss is another name for the basement complex. Slaty gneiss is a name given by miners to an easily cleavable kind.

**Gradation.** "The process of natural transferrence, by external forces, of solid material in particles or masses from one part of the earth's surface to another. The regulation of a surface into a uniform grade or slope. In the formation of plains two courses are followed, viz., the *degradation* of the district above the determined level and the *aggradation* of the tracts below it."

**Granite** (Italian *granito*). The typical acid plutonic rock, composed essentially of quartz and an alkali felspar, with or without muscovite, biotite, hornblende, one

or several. Granites commonly contain two kinds of felspar: orthoclase, or microline, and a plagioclase, commonly oligoclase. In pegmatites there is ordinarily but one felspar. Various accessories, such as magnetite, apatite, and zircon, are nearly always found. According to the mineral composition granites are known as *binary* (quartz and felspar only), *muscovite, muscovite-biotite, biotite, biotite-hornblende,* and *hornblende granites. Augite, tourmaline,* and *epidote granites* are rarer. Granite containing biotite but no muscovite is sometimes called *granitite;* that with hornblende was formerly called *syenite;* fine-grained granite with no mica, or with very little muscovite, is *aplite* or *haplite.* By insensible gradations granite passes into gneiss and other metamorphic rocks, giving rise to various phases, such as *gneissoid granite,* in which there is a tendency to a parallel arrangement of the mica. *Graphic granite* is strictly a form of *pegmatite* in which the quartz is so arranged as to resemble Hebrew or cuneiform writing. *Porphyritic granite* and *granite porphyry* contain phenocrysts of felspar in a fine-grained base.

**Graphite** (Gr. *grapho,* I write). A metallic, iron-black to dark steel-gray sectile, flexible variety of carbon, crystallizing in the hexagonal system. It is used extensively in the arts, furnishes the lead of pencils, is employed as a lubricant for machinery, for commutator brushes in dynamos, as an element in certain battery compounds, etc.

**Graptolite** (Gr. *graptos,* marked with letters, and *lithos,* stone). An animal belonging to an extinct class, the Hydrozoa, whose remains on the older palæozoic rocks resemble writing.

**Gravel.** Small stones or fragments of stones. The pebbles which compose a gravel are pieces of individual rocks and like them are generally made up of grains of different kinds of minerals. See *detritus.* The committee on Road Materials, Am. Soc. Civ. Engineers, 1915, gives the following:

"*Gravel.* Small stones or pebbles usually found in natural deposits more or less intermixed with sand, clay, etc., but in which mixture, the particles which will not pass a 10-mesh sieve predominate, gravel clay, gravel sand, clayey gravel, and sandy gravel indicate the varying proportions of the finer-sized particles. The differ-

entiation between gravel, sand, silt, and clay should be made on the following basis:

Retained on a 10-mesh sieve.....Gravel
Passing a 10-mesh and held on a 200-mesh sieve..Sand
Passing a 200-mesh sieve.....Silt or Clay"

**Graywacke.** A sedimentary rock composed of rounded or sub-angular grains of quartz, felspar, various ferromagnesian and other minerals or rock fragments, in a siliceous, argillaceous, or calcareous cement.

**Greensand.** See *glauconite.*

**Greenstone.** A field name for compact igneous rocks that have developed enough chlorite in alteration to give them a green cast. In a measure synonymous with trap. Obsolescent.

**Greisen** (Ger. *greissen,* split). A granitoid but often somewhat cellular rock, composed of quartz and muscovite or some related mica rich in fluorine. Characteristic mother rock of the ore of tin, cassiterite, and is, in most cases, due to the contact metamorphism of granite during the intrusion of pegmatite.

**Grit.** Coarse sandstone.

**Grossularite.** See *garnet.*

**Groundmass.** The finely crystalline or glassy portion of a porphyritic rock as contrasted with its phenocrysts.

**Guano** (Peru. *huama,* dung). Phosphatic accumulations, the excrement of sea birds, found in the dry climate of the Peruvian coasts and upon islands, and useful as fertilizers.

**Gumbo.** Soils that yield a sticky mud when wet; the mud of prairies.

**Gypsum** (Gr. *gupsos,* chalk). A hydrous calcium sulphate, massive, foliated, or granular, pearly, white, red, yellow, blue, or black, transparent to opaque, crystallizing in the monoclinic system. It is used as a dressing for soils, and sometimes in brewing, to burtonize soft water.

**Halleflinta.** Swedish name for a dense, compact, cryptocrystalline metamorphic rock resembling hornstone, consisting of microscopic quartz, and felspar crystals, with occasional phenocrysts, and sometimes hornblende, chlorite, magnetite, and hematite. They are frequently associated with gneisses, but their origin is obscure.

**Hardness** (A-S). That quality of a mineral the degree of which is determined by its power to scratch or be scratched by other minerals, as arranged in an arbitrary scale. The *scale of hardness* in general use, known as Moh's scale, is: 1. talc; 2. gypsum; 3. calcite; 4. fluorite; 5. apatite; 6. orthoclase; 7. quartz; 8. topaz or beryl; 9. corundum; 10. diamond.

**Hard-pan.** A layer of hard detritus, practically impermeable, under soft soil. In glaciated regions it is usually a dense compact boulder-clay; elsewhere, a substratum of ochrey clay, or detritus cemented by iron oxide or by some organic compound.

**Halite.** Native salt; sodium chloride, cubic in crystallization and cleavage.

**Hematite** (Gr. *haima,* blood). An important ore of iron, the sesquioxide ($Fe_2O_3$), so called because of the ochre-red color of the powder. It occurs in splendid rhombohedral crystals, and in massive and earthly forms (red ochre).

**Holocrystalline** (Gr. *holos,* whole). Applied to rocks wholly composed of crystalline constituents.

**Hornblende** (Ger. *horn,* metal, and *blenden,* to deceive, because containing no metal, although of metallic lustre). The greenish-black and black varieties of amphiboles, constituting the chief mineral species of that group.

**Hybrid** (L. *hybrida,* mongrel). Harker's name for igneous rocks which result from the commingling of two distinct magmas or from the absorption of solid rocks by molten magmas. They are contrasted with the products of differentiation.

**Hydro-carbons.** A series of natural compounds running parallel with the coals; the bitumens, as asphaltum, formed very much in the same way as coals and sometimes mistaken for coals, as in the case of *albertite* (Albert Co., N. B.) and *torbanite* (Torbane Hill, Scotland), amorphous dull-brown hydro-carbon derivatives closely resembling cannel coal. Coals are insoluble, or nearly so; bitumens are soluble in ether, benzole, and spirits of turpentine.

**Hydrogenic** (Gr. *hydra,* the water-snake, from *hudor,* moisture, and *genesis,* origin). Name proposed by Grabau for rocks that are due to the agency of water. More

comprehensive of the precipitates from solution, such as rock-salt, stalagmitic marble, etc., than is sedimentary. It forms a logical member in the sequence, pyrogenic; hydrogenic; atmogenic.

**Hydrosphere** (Gr. *hudor,* water, and *sphaira,* sphere). The aqueous envelope of the earth.

**Hydrozoa** (Gr. *hydra,* and *zoon,* a living being). A class of coelenterate animals, including the hydra, the sea-firs, and the extinct graptolites.

**Hypersthene** (Gr. *huper,* and *sthenos,* strength; "strong above others," superior in lustre and hardness to amphibole, with which it has been confounded). A pearly, dark-colored, translucent, brittle, ferrous magnesium pyroxene, often exhibiting the peculiar metallic lustre called schiller. Orthorhombic.

**Iceland spar.** Popular name for transparent calcite used for polarizing light, found to perfection in Iceland.

**Igneous rocks.** Rocks formed by the action of heat intense enough to produce fusion; rocks formed from the cooling or freezing of a magma, consolidated from a molten state. Those which solidified before reaching the surface are known as *plutonic,* or *deep-seated,* and *intrusive;* those which flowed out upon the surface, and there cooled, are called *volcanic, effusive,* or *extrusive.* The plutonic rocks are holocrystalline, and coarsely crystalline, the coarseness of crystallization being a measure of the rate of cooling, of the depth at which cooling took place, and of the amount of erosion the region has suffered since the rocks were formed. The intrusive rocks in dikes and sills are finely granular, porphyritic, or hypocrystalline. The extrusive rocks, or volcanics, may be hypocrystalline or felsitic, or lithoidal, or glassy, or pumiceous, or scoriaceous.

**Lignite,** or *brown coal,* usually retains the texture of the wood from which it is derived. It is intermediate between peat (from which it is sometimes derived) and bituminous coal, and has over 50 per cent of volatile matter. On drying out it usually cracks badly, and hence should be used near the point of production unless it is formed into briquettes or utilized in a gas producer.

**Ilmenite** (named from the Ilmen mountains, a range of

the Urals). A sub-metallic, iron-black, opaque, titanium-iron oxide, crystallizing in the hexagonal system.

**Inclusions.** Crystals and anhedra of one mineral involved in another; fragments of one rock inclosed in another, as when a volcanic flow picks up portions of the country-rock.

**Infusorial earth.** Diatomaceous earth. See *diatoms.* A very fine earthy material, consisting chiefly of the minute silicious skeletons of diatoms; used as a polishing-powder, and as an absorbent of nitro-glycerine.

**Intratelluric** (L. *intra,* within, and *tellus,* the earth). Referring to the first of two stages of the solidification of a porphyritic rock from fusion, when the phenocrysts are formed at great depths within the earth and intruded or extruded with the magma before the final solidification of the groundmass. The second stage is the intrusive or extrusive period.

**In Situ.** In its natural or original position or place; in position; said specifically of a rock, soil, or fossil, when in the situation in which it was originally formed or deposited.

**Intrusive.** Applied to rocks which, in a molten state, have made their way up from below into another rock or series of beds, and there cooled as dikes, cutting across bedding-planes, or as sills, intruded between the beds of the older rock. This is a common English usage; but there is a growing tendency to include under this term all rocks which solidified before reaching the surface, even the *plutonic* or *deep-seated,* as distinguished from the *volcanic, effusive,* or *extrusive,* which reached and flowed out on the surface before solidfying. See *Igneous Rocks.*

**Iron ores.** Iron is found native in small quantities, being silvery-white when pure, and very tenaceous, malleable, and ductile; it occurs native in meteorites and in certain ultra-basic dikes. It is chiefly derived from ores which are more or less impure limonites, hematites and magnetites, and from siderite as well; all of which see.

**Iron-pyrites.** (Iron- and Gr. *pyr,* fire.) Iron disulphide, pale brass-yellow and of metallic luster, crystallizing in the isometric system. Obsolescent; *pyrite* being

the more common form. *Marcasite* is pyrite crystallizing in the orthorhombic system.

**Isocline** (Gr. *isos,* equal, and *klino,* I bend). A fold in which the strata are so oppressed that both sides incline in the same direcstion.

**Itacolumite** (Itacolumi, a mountain in Brazil). A laminated, granular, friable sandstone, which is flexible in thin slabs; flexible-sandstone, first described from Brazil, but since found in North Carolina and elsewhere. Called in North Carolina "limber-grit." "It is composed of quartz grains, to whose interlocking it is supposed to owe its flexibility; of muscovite, talc, and few other minerals, and has been regarded as the mother rock of the Brazilian diamonds."

**Jasper** (Gr. *iaspis,* a precious stone of the ancients). An opaque variety of quartz, found in many colors, but most frequently red; a red chalcedony, abundant enough on Lake Superior to be a rock.

**Jaspilite** (Gr. *iaspis,* jasper, and *lithos,* stone). An acid igneous rock more silicious than rhyolite; as now used, in the Lake Superior region, a rock consisting of bands of red chert and hematite.

**Kaolin** (Kaoling, high ridge, the name of a hill in China where it is found). Hydrous aluminium silicate. A fine variety of clay resulting from the decomposition of felspar.

**Kelp.** Large coarse seaweeds burned for the chemical salts contained in their ash; the ashes of seaweeds, formerly the source of soda as used in glass- and soap-making, now a source chiefly of iodin, and for half a century the source of potash used in fertilizers around Arcachon, France.

**Keratophyre** (Gr. *kerata,* horns, and *phyr,* purple). An acid igneous rock rich in soda or other alkali, intermediate between the porphyries and the lavas.

**Killas.** Cornish miners' term for the argillaceous schist or clay slate forming the country-rock of the tin veins.

**Kimberlite** (Kimberly, South Africa). A peridotite that in large part forms the diamantiferous neck at the Kimberly mines. It is also the mother rock of the Arkansas diamonds. The rock is more porphyritic than typical peridotite.

**Kyanite** (Gr. *kyanos,* dark-blue). A blue, green, grey, or black aluminium silicate occuring usually in long blade-like triclinic crystals; found also columnar to fibrous in structure; sometimes used as a gem. Also spelled cyanite.

**Labradorite** (the best specimens are obtained from the Labrador coast). A pearly, grey, brown, or colorless, vitreous, translucent to sub-translucent lime-soda felspar, crystallizing in the triclinic system.

**Laccolite** (Gr. *lakkos,* cistern, and *lithos,* stone). A mass of intrusive rock, which spreads out laterally between strata, in lenticular forms, lifting the overlying rocks into domes. A laccolite differs from a sheet of igneous material in being proportionately thicker at the center, thus raising the strata more abruptly; but there is no sharp line of definition between these forms.

**Lamellibranch.** One of a class of mollusca including bivalve shells such as the clams, oysters, mussels, etc. See *brachiopods.* Lamellibranchs wear their shells laterally; brachiopods dorsally and ventrally.

**Lapilli** (L. dimin. of *lapis,* a stone). Volcanic dust and small fragments of lava ejected from a volcano by explosive eruptions.

**Lapis-lazuli.** A rich blue complex mixture of minerals, largely used as an ornamental stone by the ancients.

**Laterite** (L. *later,* brick). A red, ferruginous, porous clay, covering vast areas in some tropical countries. First applied to altered basaltic rocks in India. Compare saprolite.

**Lava** (L. *lavare,* to wash). Molten rock, poured out from a volcano, or through a non-volcanic fissure, or intruded subterraneously between strata; or the same material after it has hardened through cooling. In texture it may be glassy, resin-like, stony, vesicular, scoriaceous, or cellular and light (scoria and pumice). Common vesicular lavas are rhyolite, trachyte, andesite, basalt. Lava-streams are either áä or pahoehoe. See these words. If the pores in a vesicular lava become filled with some secondary mineral, as calcite, or epidote, or quartz, or copper, the rock is said to be amygdaloidal, from the Greek word for almond. See *Igneous Rocks.*

**Leucite** (Gr. *leukos,* white). A vitreous white translucent to opaque potassium-aluminium silicate crystalizing in the isometric system; especially abundant in some Italian lavas.

**Limburgite** (Limburg, Germany). A dark-colored, frequently olive-green, volcanic rock, containing olivine, augite, and glass, with magnetite and apatite.

**Limestones** are usually derived from shells or coral rock, though sometimes from the remains of calcium-secreting plants (algæ) and present a series running parallel with the coals, culminating in crystalline marbles. They are sometimes precipitated in fresh water, as in the Everglades of Florida, and at the mouth of the Rhone River in France.

**Limonite** (Gr. *leimon,* a meadow, and *lithos,* stone, name first given to bog iron ore). A stalactitic, fibrous, concretionary, silky, sub-metallic, variously shaded brown or yellow hydrous iron oxide.

**Liparite** (named from its abundance in the Lipari Islands). A European name for rhyolite, a lava rich in silica.

**Lithosphere** (Gr. *lithos,* stone, and *sphaira,* sphere). The stony crust of the earth.

**Loam.** A mixture of sand, clay and organic matter, the percentage of clay varying between 25 and 50 per cent; hence the terms *clay loam* and *sandy loam.* It may be colored yellow, brown, or reddish by iron oxides, or dark to black from organic matter.

**Lode.** Mining term for a metallic vein; any regular vein or course, whether metallic or not.

**Loess.** A pale, usually yellowish, homogeneous, calcareous clay, loam or fine sand, of Pleistocene age, found mainly bordering river valleys or forming valley bluffs, and extending over a wide area of Europe, Asia, and the United States of eolian origin and frequently rain-washed.

**Magma** (Gr. *magma,* a kneaded mass, a salve). The fused or molten material from which igneous rocks are formed. When a magma reaches the surface it becomes a lava.

**Magnesite.** A massive, granular, compact, vitreous,

white to brown magnesium carbonate, crystallizing in the hexagonal system.

**Magnetite.** A magnetic iron oxide, which when pure contains *72%* of iron, and crystallizes in the isometric system: an important iron ore. It sometimes possesses polarity, and is then called lodestone.

**Malachite** (Gr. *malache,* mallow, from its resembling the green color of the leaf of mallows). Hydrous copper carbonate, usually occurring in green mammillary masses with concentric fibrous structure.

**Mammillary** (L., dim of *mamma,* a breast). Composed of convex concretions, somewhat resembling the breasts in form; studded with small mammiform protuberances.

**Mantle-rock.** The loose fragmental material resulting from the disintegration of the hard rocks and covering the greater part of the earth's surface; rock waste; forms greater part of the *regolith.*

**Marble** (O. E. *marbel*). A massive, compact limestone; especially a massive variety of calcite, capable of being polished and used for architectural and ornamental purposes. The color varies from white to black, being sometimes yellow, brown, red, and green, and frequently beautifully veined or clouded. The name is also given, improperly, to other rocks of like use and appearance, as serpentine or verd antique marble, and even less properly to polished porphyry and granite. *Statuary marble* is a pure, white, fine-grained kind, including *Parian* (from Paros) and *Carrara marble.* If coarsely granular it is called *saccharoidal.*

**Marcasite.** See Iron-pyrites.

**Marine deposits.** "About one-half the waste of the land is carried directly into the sea, while the rest is arrested in its journey and deposited upon the land." *Scott.* Marine deposits are typically stratified, and their marine origin is recognized by means of their contained fossils. They are wide in extent, often of great thickness, and present a great variety of genera and species. See *Freshwater deposits.* The following table from Murray shows the relations of the various groups of marine deposits now forming:

| | | |
|---|---|---|
| 1. Deep-sea deposits beyond 100 fathoms ..... | Red clay, Radiolarian ooze, Diatom ooze, Globigerina ooze, Pteropod ooze | I. Pelagic deposits formed in deep water far removed from land. |
| | Blue mud, Red mud, Green mud, Volcanic mud, Coral mud | II. Terrigenous deposits formed in deep and shallow water, mostly close to land. |
| 2. Shallow-water deposits between low-water mark and 100 fathoms | Sands, gravels, muds, etc. | |
| 3. Littoral deposits between high and low-water marks | Sands, gravels, muds, etc. | |

**Meerschaum** (Ger. lit. sea-foam). A compact, soft, white, hydrous magnesium silicate, which when dry will float on water. Used for tobacco-pipes, cigar-holders, etc.; but in Spain it is used as a building stone, and in Algeria as a soap for bathing purposes.

**Melaphyre** (Gr. *melas,* black, and *porphyrites*). Any igneous porphyry with a dark groundmass.

**Merocrystalline** (Gr. *meros,* a part). A term applied to rocks composed in part of crystalline constituents.

**Mesozoic** (Gr. *mesos,* middle, and *zoe,* life). The middle era in the ongoing of life; the fourth of the five eras into which geological time is divided.

**Metallogenetic epochs.** Periods of time during which deposition of metals was taking place, usually coincident with or immediately following periods of igneous activity. The process has been active during a number of periods in the past. See Lindgren, Econ. Geol. IV, 409, 1909.

**Metamorphism** (Gr. *meta,* after, as in physics and metaphysics; and *morphe,* form). Changes in rocks due to recrystallization of their constituents, either with or without chemical alteration of the mass, by which they are made to assume new forms and enter into new combinations, the most important result of these changes being that the rock becomes harder and more crystalline in structure.

*Contact* or *local metamorphism* is brought about by and confined to the neighborhood of an intrusive mass of igneous rock; *dynamic metamorphism* is induced by

earth-movements or mountain-building action involving great folding, shearing, and crushing; *general* or *regional metamorphism* extends over a large area, and is produced by pressure and the blanketing-in of heat without great shearing or dislocation of the rock-masses. See *Epigenetic.*

**Metasomatism** (Gr. *meta,* after, and *soma,* body). A change in a rock which alters its composition.

**Metazoa** (Gr. *meta,* after, and *zoe,* life). The subkingdom of animals in which each animal is composed of many cells.

**Meteoric iron.** Meteorite, a mass of stone or iron that has fallen upon the earth from the celestial spaces.

**Meteoric waters.** Condensed atmospheric vapors, through which physiographic processes are carried on. Underground, they have to do with the formation of veins, replacements, and residual ore deposits; on the surface, by their chemical action they form bog iron ores, sinters, etc., and by their mechanical work they concentrate gold and tin in placers.

**Miarolitic** (Gr. *miaros,* defiled, and *lithos,* stone). Containing small, irregular, evenly distributed interstitial cavities, commonly lined with small projecting crystals; applied to the texture of some igneous rocks.

**Micas** (L. *micare,* to glitter). A series of aluminium silicates, with potassium, magnesium, or iron, or all of these, having a prismatic angle of 120°, perfect basal cleavage, splitting into thin, tough, elastic laminæ or scales, colorless to jet-black, transparent to translucent, of widely varying chemical composition, and crystallizing in the monoclinic system. The two marked types are *muscovite,* rich in aluminium and potassium, the common alkali mica, with a silvery aspect, and *biotite,* the common dark ferro-magnesian mica.

**Microcline.** See *Felspars.*

**Mineralizer.** An element that combines with a metal to form an ore, as sulphur. A volatile or other substance, as fluorine, boron or water, that facilitates the recrystallization of rocks, as in contact zones around eruptive masses.

**Mineralogy.** The science which treats of minerals, and teaches how to describe, distinguish, and classify them.

**Minerals.** Inorganic constituents of the earth's crust,

having theoretically a definite chemical composition that may be expressed by a formula, and, under favorable conditions, a regular geometric form.

The prominent minerals of the igneous rocks are given in the following table, after Pirsson:

| SALIC GROUP | FERROMAGNESIAN GROUP |
|---|---|
| Alkalic Felspar | Pyroxenes |
| Plagioclase Felspar | Amphiboles |
| Quartz | Biotite |
| Nephelite | Olivine |
| Sodalite | Iron Ores |
| Corundum | |

**Miocene** (Gr. *meion,* less, and *kainos,* recent). The middle period of recent life; the middle period of the Cenozoic Era.

**Mollusca** (L., meaning a soft nut with a thin shell, from *mollis,* soft). The group of animals including the so-called "shell-fish."

**Monazite** (Gr. *monazein,* be solitary). A phosphate of the cerium metals, usually containing some thorium silicate. "It is a rare mineral, occurring in small brownish-red or yellowish-brown monoclinic crystals, also massive with resinous luster, and is found in Norwich in Connecticut, and in North Carolina, among the Urals, and elsewhere. It is a prominent accessory constituent of granitic rocks in some localities, and when these rocks have been disintegrated by natural causes it has been (as in North Carolina and Brazil) obtained, by washing the gravels, in very large quantities." *Cent. Dict.*

**Monocline** (Gr. *monos,* single, and *klino,* I bend). An abrupt downward folding of nearly horizontal strata, without any corresponding bend to form an anticline or syncline.

**Muscovite.** See *Micas.*

**Natrolite.** A zeolite occurring in groups of glassy acicular crystals, and in masses which often have a radiated structure. It is hydrous aluminium-sodium silicate.

**Nebula** (Latin for a cloud). A star composed of clouds of gas or a swarm of meteoric masses.

**Nepheline** (Gr. *nephile,* a cloud). A silicate of aluminium, sodium, and potassium, occurring in glassy-white

or yellow hexagonal crystals or grains in volcanic rocks; nephelite.

**Novaculite** (L. *novacula,* razor). An extremely fine-grained sedimentary siliceous rock used for hones; Arkansas-stone; whetstone.

**Nullipore.** A red-spored coral-like seaweed of the order *Corallinaceae,* secreting lime.

**Obsidian.** A general name for volcanic glass.

**Ocher** (Gr. *ochra,* pale yellow). An impure earthy ore of iron or a ferruginous clay, usually red (hematite) or yellow (limonite), used as a pigment in making paints.

**Odor or Smell.** Solid minerals are usually without odor unless subject to some special treatment, as heating, rubbing, moistening, etc. The principal kinds of odor are the *sulphurous, arsenical, argillaceous,* and *fetid.*

**Oligocene** (*Oligos,* little and *kainos,* recent). The second in time of the five systems of the Cenozoic Era.

**Oligoclase.** See *Felspars.*

**Olivine.** A silicate of magnesium and iron, transparent to translucent, commonly of an olive-green color, crystallizing in the orthorhombic system; used as a gem when transparent, and called *peridot,* or *crysolite.*

**Oölite** (Gr. *oön,* an egg, and *lithos,* stone). A granular limestone, each grain of which is more or less completely spherical, and made up of concentric coats of carbonate of lime formed around a minute nucleus, usually a grain of sand. The rock is so called from its resemblance to the roe of a fish.

**Opal.** Uncrystallized silica with some water.

**Ophicalcite.** A coarsely-crystalline marble containing serpentine.

**Orbicular.** In igneous rocks, crystallization of component minerals in spheroids; as, orbicular diorite, orbicular granite.

**Ore** (A-S). A natural substance, sometimes forming part of a rock containing one or more metals; the combination of a metal with a mineralizer. The term is applied usually to a mineral from which the metal may be extracted with profit, but is sometimes extended also to non-metallic minerals; as, sulphur *ore.*

**Orthoceras** (Gr. *orthos,* straight, and *keras,* a horn). A chambered shell, like a straight uncoiled nautilus.

**Orthoclase.** See *Felspars.*

**Orthophyre.** See *Porphyry.*

**Pahoehoe** (Hawaiian). A smooth-surfaced lava-stream. When the natives of Hawaii first saw satin cloth they described it as pahoehoe. Se *á-ä.*

**Palæozoic** (Gr. *palaios,* ancient, and *zoe,* life). The era of ancient life. The third of the five great geological groups or Eras.

**Pea Gravel.** Clean gravel the particles of which equal peas in size.

**Peat** consists of partially carbonized vegetable material, the result of the decomposition of various plants in the presence of water; found usually in marshes, bogs, etc. "A peat-bog represents the accumulated remains of thousands of generations of plants." *Le Conte.*

**Pegmatite** (Gr. *pegma,* anything congealed). A very coarse-grained granitic rock composed of quartz, orthoclase, and mica (usually muscovite); a name originally applied to graphic granite. The essential minerals of pegmatite, and the many accessories, such as tourmaline, beryl, fluorite, etc., show simultaneous crystallization.

**Pele's hair** (Pele, a local goddess). Basaltic glass from the Hawaiian Islands, which, while fused, has been blown by the wind into long delicate fibers or threads.

**Pelite** (Gr. *pelos,* clay, earth, mud). A general name for mud rocks, such as clay, shale, etc.

**Peridotite** (Fr. *peridot,* an early name for crysolite or olivine, still used in France). An ultra-basic, granular, igneous (plutonic) rock, composed essentially of olivine, with or without pyroxene, hornblende, mica, spinel, magnetite, pyrrhotite; the mother rock of many valuable ores, and of diamonds in South Africa and in Arkansas.

**Perlite** (Fr. *perle,* pearl). An acid igneous glassy rock of the composition of obsidian, but divided into small spherical bodies by the tension developed by its contraction on cooling.

**Petrology** (Gr. *petron,* rock, and *logos*). The science concerned with the mineralogical and chemical composition of rocks, and with their classification; lithology.

**Petrosilex.** An old name for very fine crystalline porphyries, and for those finely crystalline aggregates we now know to be devitrified glasses.

**Phacolith** (Gr. *phacos,* lens of the eye, and *lithos,* stone). A lenticular intrusion.

**Phenocrysts** (Gr. *phainein,* to show, and *krust* (*allos*), crystal). One of the prominent crystals in a porphyritic rock.

**Phonolite** (Gr. *phonea,* sound, and *lithos,* stone). A felsitic lava, sometimes slightly porphyritic, rich in soda. It gives forth a ringing sound when struck with a hammer, and is used for rock harmonicons: hence its name. Clinkstone.

**Phyllite** (Gr. *phillites,* belonging to leaves). An argillaceous schist, intermediate between slate and mica schist and usually finely crystalline.

**Pisolite** (Gr. *pisos,* pea, *lithos,* stone). A coarse oolitic or concretionary limestone, composed of calcite or aragonite globules with a distinct concentric structure, and often as large as small peas. *Pisolitic,* like or consisting of pisolite; as, pisolitic bauxite, pisolitic iron ore.

**Pitchblende.** A massive form of uraninite, noted for its radio-activity and as the chief source of radium. It is black or brown, with a luster like pitch, and is found in certain mines of Bohemia, Saxony, Cornwall, Colorado, and North Carolina.

**Plagioclase.** See *felspar.*

**Pleistocene** (Gr. *pleistos,* most, and *kainos,* recent). The last of the five systems of the Cenozoic Era.

**Pliocene** (Gr. *pleion,* more, and *kainos,* recent). The fourth in time of the five systems of the Cenozoic Era.

**Plutonic** (named for Pluto, the god of the infernal regions). Name applied to igneous rocks that have solidified deep below the surface of the earth. They are granitoid in texture and coarsely crystalline.

**Pneumatolysis** (Gr. *pneuma,* breath, spirit). The process of forming pneumatolytic minerals. *Pneumatolytic,* produced during the later processes in consolidating molten rock-magmas under the influence of the concentrated gaseous or vaporous mineralizers which are then present. See *Endomorphic.*

**Porcellanite.** Clay metamorphosed into a rock resembling porcelain or earthenware in texture and appearance. Common in lignite districts in the West,

where, apparently, spontaneous combustion has fired the coals and baked their roofing clays. Also spelled *porcelanite.*

**Porphyrite.** See *porphyry.*

**Porphyry** (Gr. *porphyra,* purple). The word is derived from the classic name of the mollusc, a kind of conch, used to dye the Tyrian purple of the ancients. The term was later applied to a stone quarried by the Egyptians in the neighborhood of the Red Sea. It was dark-crimson or purplish: hence the name. A similar stone of a green color was quarried in Greece. Much of the porphyry used in Rome came from Sardinia. P. is any acid igneous rock that has a cryptocrystalline or felsitic groundmass enclosing crystals of felspar or quartz. If p. contains quartz it is known as *quartz-porphyry;* if not, as *quartzless porphyry* or *orthophyre.* If p. contains a lime-soda instead of an alkaline felspar, it is called *porphyrite;* if it has an amorphous glassy base it is called *vitrophyre.*

**Pozzuolana.** A volcanic ash, first collected at Pozzuoli, near Naples: used as a hydraulic cement.

**Proterozoic** (Gr. *proteros,* fore, and *zoe,* life). The name of the second of the five geological eras, lying above the archæozoic and beneath the palæozoic. The time during which the simplest life forms developed. Essentially synonymous with *algonkian* of the U. S. Geological Survey, but erected by Chamberlin and Salisbury into an independent era with three well-marked sub-divisions, Keweenawan, Animike, and Huronian.

**Protozoa** (Gr. *protos,* first, and *zoe,* life). The lowest group of the animal kingdom, including animals composed of only one cell, or of a few exactly similar cells.

**Psammites** (Gr. *psammites,* of sand, sandy). A general name for sandstones; a fine-grained sandstone.

**Psephites** (Gr. *Psephos,* a pebble). A general name for conglomerates and breccias; a coarse conglomerate with argillaceous cement.

**Pseudomorph** (Gr. *pseudes,* false, and *morphe,* form). Replacement of one mineral by another, such that the form of the first is preserved by the second; a mineral having the same external form as another mineral, as

the result of a chemical or molecular change or substitution.

**Psychozoic** (Gr. *psyche,* soul, mind, and *zoe,* life). A term used by some geologists to designate the present time, and an indefinite portion of the pleistocene period, when man is the dominant type and mind rules the earth. It is erected by them into a sixth and independent era.

**Pudding-stone.** A conglomerate rock containing numerous rounded pebbles.

**Pumice** (L. *spuma,* foam). Lava that is cellular or spongy from bubbles of steam or gas which it contained while liquid: used as a polishing material, especially when powdered; also as *pumice-stone.*

**Pyrite.** See *Iron-pyrites.*

**Pyroclastic** (Gr. *pyro,* fire, and *klastos,* broken). Applied to fragmental rocks, such as tuffs and breccias, made from volcanic ejecta.

**Pyrogenic.** Applied to igneous rocks, which have originated through the agency of heat. See *atomogenic* and *hydrogenic.*

**Pyrolusite** (Gr. *pur,* fire, and luein, to loose). Manganese dioxide, a mineral of an iron-black or dark steel-gray color and metallic luster, usually soft. Pyrolusite parts with its oxygen at a red heat, and is extensively used in discharging the brown and green tints of glass.

**Pyrophyllite** (Gr. *pur,* fire, and *phillon,* leaf; so-called in allusion to its exfoliation before the blowpipe). A hydrous aluminium silicate, occurring in foliated, often acicular and radiated, talc-like substransparent masses having a white, green, or yellow color and pearly luster.

**Pyroxenes** (Gr. *pyro,* fire, and *xenos,* guest). A group of rock-forming minerals, embracing many varieties and exhibiting a wide range in composition. Bisilicate minerals having a prismatic angle of about 87° and corresponding usually to the formula $RSiO_3$ (in which R may be magnesium, frequently replaced in part by iron, calcium, manganese), crystallizing in either the orthorhombic, monoclinic, or triclinic system. The monoclinic varieties, usually normal metasilicates corresponding to the formula given, are of various colors

from very light green to dark-brownish green and black. Monoclinic varieties include *diopside, hedenbergite, schefferite,* and *augite.*

**Pyroxenite.** A rock composed almost wholly of pyroxene and lacking olivine. Websterite is a variety from North Carolina, consisting of diopside and bronzite.

**Pyrrhotite.** A bronze-colored mineral of metallic luster. It is a sulphide of iron, and is remarkable for being attracted by the magnet. Called also *magnetic pyrites.*

**Quartz.** A silicon dioxide, silica, either massive or crystallizing in the hexagonal system, and varying greatly in luster, transparency, and color. It is the hardest of the common minerals (7), is fusible only by the oxy-hydrogen flame or the electric furnace, and resists all acids except hydrofluoric. It abounds in practically all rocks, and is an essential constituent of granite. The name of the mineral is prefixed to the names of many rocks that contain it; as, quartz-porphyry, quartz-diorite, quartz-schist, etc.

**Quartzite.** Metamorphosed sandstone, frequently formed by the deposition of secondary quartz around the grains cementing them together, and crystographically continuous with the original grain.

**Quaternary** (L. *quatuor,* four). A system in geology including all deposits later than Tertiary. The Quaternary is ordinarily included in the Cenozoic, but some geologists separate it and include it in a Psychozoic Era.

**Radiolaria** (L. *radiolus,* a little rod). A group of simple animals belonging to the protozoa and usually having siliceous shells.

**Radium** (L. *radius*). A very highly radioactive metallic element obtained from the uranium mineral pitchblende, by Pierre Curie, Mme. Curie, and G. Bémont in 1898, and now known (combined) in minute quantities in various other uranium minerals. Its compounds color flames carmine and give a characteristic spectrum. It resembles barium chemically. Radium preparations are remarkable for maintaining themselves at a higher temperature than their surroundings, and for emitting three very distinct kinds of rays which ionize gases, affect photographic plates, cause sores on the skin, and

produce many other striking effects. The mineral carnotite, found in western Colorado, is an important source of radium.

**Regime** (French). The stage reached by a river when it neither wears away its bed nor deposits material on it.

**Regional-metamorphism.** See *Metamorphism.*

**Regolith** (Gr. *rhegos,* cover, and *lithos,* stone). The mass of unconsolidated earthy material which overlies the solid rocks, considered as a whole, whatever its origin or chemical nature, or whether it is residual or transported. Used by Merrill, in Rocks, Rock-weathering, and Soils.

**Resorbed.** A term used to describe those phenocrysts which, after crystallization, are partly fused again into the magma.

**Reticulate.** Having an interlaced net-work arrangement; as, lead carbonate.

**Rhodonite** (Gr. *hrodon,* rose). Manganese spar or silicate of manganese; a mineral occurring crystallized (triclinic) and in rose-red masses, often used as an ornamental stone.

**Rhyolite** (Gr. *rhuo,* I flow, and *lithos,* stone; *rias,* a stream of lava from a volcano). A highly acidic, compact or porphyritic, variously colored volcanic rock, showing flow-structure, though sometimes perlitic, having a glassy groundmass, and consisting of quartz and orthoclase, with either mica or hornblende.

**Rock** (A-S). The material forming the earth's crust or lithosphere or any portion of it; any aggregate or mass of mineral matter forming an essential part of the earth's crust. The term rock as used in geology includes the loose material as well as the solid parts of the earth. A stone is a small piece of rock. Fields are enclosed by stone fences, not rock walls.

Rocks, if formed from fusion are called *igneous rocks.* The rocks covering the greater part of the earth's crust have been formed by erosion of the older rocks, by transportation of the detritus, and its deposition under water. These are called *clastic, sedimentary,* or *fragmental rocks.* When they are deposited in layers or beds they are called *stratified,* to distinguish them from the *igneous,* which are essentially *unstratified.* See *Metamorphism.*

**Rock-salt.** Sodium chloride.

**Rutile** (L. *rutulus*, red). An adamantine, reddish-brown, transparent to opaque titanium dioxide, crystallizing in the tetragonal system, and usually containing a small quantity of iron.

**Salic.** Name derived from silica-alumina, used to indicate igneous rocks with predominant light-colored minerals as quartz and felspar.

**Samarskite** (Samarski, a Russian mine-officer). A vitreous to resinous, velvet-black tantalo-columbate of the cerium and yttrium metals, $(Fe, Ca, VO_3)_3$ (Ce, Di, La, Yt, Er)$_2$ (Cb, Ta)$_6$ $O_{21}$, crystallizing in the orthorhombic system: the source of many of the cerium and yttrium elements, including several that have not been acknowledged generally by chemists, as mosandrium, decipium, and philippium.

**Sand** (A-S). Comminuted fragments and water-worn particles of rocks (mainly quartz) large enough to be easily visible to the naked eye, but not so large as to be regarded as gravel. Felspar is frequently present, and, if abundant, the sand is then called *arkose*. Flakes of muscovite, which decompose slowly, are often mixed with quartz and felspar in sand. Magnetite is also frequently abundant in sands derived directly from granitic and crystalline rocks. Other rock-making minerals which occur in fine grains in sand are garnet, tourmaline, zircon, rutile, and anatase, which are hard and resistant to decomposition.

In the Lizard district of Cornwall the sands at the base of cliffs of serpentine are rich in olivine, augite, enstatite, tremolite, and chromite. Near volcanic islands such minerals as bioteme, hornblende, augite, and zeolites may form a large portion of the local sand deposits. Among the accessory ingredients of sands which are of great value are the precious metals, gold and platinum. Tin-stone also occurs in this way in Ceylon, Burma, Brazil, and South Africa; monazite is found in sands derived from granitic rocks in Brazil and in North Carolina; precious stones, such as the diamond, ruby, sapphire, spinel, chrysoberyl, and tourmaline are found in beds of sand and gravel—gem sands.

Near the parent rock sand consists of angular grains, and sea-borne sand grains are more or less sharp and

angular because of the low sp. gr. of quartz and the density of sea water, though they are occasionally rounded or oviform from mutual attrition on a sea shore, while sands borne by the wind are more or less rounded. In desert regions one may sometimes see fine quartzose sands with every grain smoothed and polished. These sands flow almost like a liquid, and are used in hour-glasses. Blown sands are also found along sea shores, bordering large rivers, and on the margins of some great lakes. These form hillocks or dunes which are frequently destructive to forests, fields, and houses. Glacial sands are common in districts like New England, which have been covered by an ice-sheet. Around coral islands and on the shores of some lands of organic origin, like the Florida peninsula, there are coral sands and shell sands, which do not long remain as such but are soon dissolved, or else consolidated by cementation.

"Finely divided rock detritus the particles of which will pass a 10-mesh and be retained by a 200-mesh screen." Am. Soc. Civ. Eng., 1915. Also see *gravel.*

Sand, when consolidated by pressure or held together by some cement, becomes *sandstone;* and a large part of the material forming the series of stratified rocks is sandstone. Many of the Tertiary sandstones, and even some earlier ones, are so incompletely consolidated by cementation that they are essentially sandrocks, and are sometimes used as sources of sand, as the Bagshot sands of Britain. Sand is used for glass-making, for mortar and cement, for filtering, and for etching glass and other substances by means of the sand blast.

**Sandstone.** See *sand,* last paragraph.

**Saprolite** (Gr. *sapros,* rotten). Thoroughly decomposed, earthy, but untransported rock.

**Schist** (Gr. *schistos,* cloven; from *schizo,* cleave). Any rock that splits readily or cleaves; specifically, a rock that has a parallel or foliated structure secondarily developed in it by shearing, a process generally accompanied by more or less recrystallization of the constituent minerals in layers parallel to the cleavage. The secondary foliation or schistosity may be, but generally is not, parallel to the original bedding. Slates and schists are not necessarily different rocks, both having a secondary cleavage produced by dynamic ac-

tion; but the term *slate* is usually reserved for an argillaceous rock with perfect cleavage, in which crystallization has but begun, as a roofing slate, though there is also an igneous slate made from the shearing of a fine-grained igneous rock of uniform texture. Rocks that have been entirely recrystallized by metamorphism are called *crystalline schists.*

**Scree** (A-S *scrithan,* to go or creep). Talus. In common use in England.

**Sedimentary rocks** are those whose materials have been sorted and deposited from suspension in water; as, conglomerates, sandstones, and shales.

**Septaria.** Nodules or concretions, largely argillaceous. filled with a little net-work of veins. Popularly called turtle-stones.

**Serpentine.** A metamorphic rock consisting chiefly of the mineral serpentine, which is a massive to fibrous, sub-resinous to greasy-lustered, hydrous, earthy, green, red, yellow, translucent to opaque magnesium silicate. The coarser varieties are used for building purposes, the more highly colored and compact varieties for interior decoration.

**Shale** (Gr. *schale*). A fine-grained argillaceous rock of a thin, laminated, and often friable structure.

"The name clay is used for argillaceous deposits which still retain enough moisture to be plastic. By the loss of most of their combined water, and by other more important changes these pass into mudstones, *shales,* and slates. Of these terms, mudstone is correctly used when the rock has no marked fissile character, *shale* when it splits along the original laminae of deposition, and slate when the original lamination has been superseded as a direction of weak cohesion by a new structure." *Harker.*

**Siderite** (Gr. *sideros,* iron; *sidera,* stars). A vitreous gray, brown, brownish-red translucent iron carbonate, crystallizing in the rhombohedral division of the hexagonal system. Cleavage and luster like calcite. When pure, important as an iron ore.

**Silt.** A muddy deposit of fine sediment in bays or harbors; soil whose constituent grains are .05-.005 mm. in size.

**Sinter** (Gr. *sinter,* dross of iron). Mineral matter

deposited by springs, either calcareous, as calc-sinter, travertine, tufa; or siliceous, as siliceous sinter.

**Slate.** Any rock that splits readily into thin and even laminæ. Slates are distinguished chiefly according to their characteristic constituent; as argillaceous or clay slate, bituminous s., calcareous s., chlorite s., damourite s., diorite s., hornblende s., hydro-mica s., mica s., ottrelite s., siliceous s., staurolite s., talcose s., and several others, these names indicating the diverse rocks that may be sheared into slates.

**Slickensides.** Polished surfaces along walls, or fractures, produced by the rubbing of the walls upon each other during movement.

**Sodalite.** A vitreous, colorless, gray, blue, or red, transparent to translucent, sodium-aluminium chlorsilicate, crystallizing in the isometric system. It is commonly found in volcanic rocks.

**Soil.** Finely divided rock material mixed with decayed vegetable or animal matter, constituting that portion of the surface of the earth in which plants grow or may grow; the earthy material that covers naturally the rock-surfaces of the earth.

The existence of soil over any area implies a previous decomposition of the rocks, and climatic conditions favorable to the growth of vegetation.

**Sphalerite** (Gr. *sphaleros,* slippery, uncertain). Zinc sulphide; a pale yellow to brown, brittle, resinous, translucent to opaque mineral, crystallizing in the isometric system, usually tetrahedrons, with perfect dodecahedral cleavage. Called also *blende, black-jack, false galena,* etc.

**Spodumene.** A mineral of a white to yellowish, purplish, or emerald-green color, occurring in prismatic crystals (monoclinic) often of great size. It is a silicate of alumina and lithia. An emerald-green variety found in North Carolina is used as a gem, called *hiddenite.*

**Stalactite** (Gr. *stalactos,* dripping, oozing out in drops). A deposit of carbonate of lime, usually resembling in form a huge icicle, which hangs from the roof of a cave, or subterranean rock-opening, where it has been slowly formed by deposition from calcareous water trickling downward through cracks or openings in the rocks above. Compare *stalagmite.*

**Stalagmite.** Carbonate of lime deposited on the floor of a cavern, usually in columnar form, made by the dropping of the solution from the roof, or from a depending stalactite.

**Steatite.** Soapstone.

**Stibuite.** A mineral of a lead-gray color and brilliant metallic luster, occururing in prismatic crystals (orthorhombic); sulphide of antimony. Called also *antimony glance,* and *gray antimony.*

**Stock.** A large columnar intrusion of igneous rock, the length and breadth of which are roughly equal. A stock may be the deep-seated and eroded portion of a volcanic neck or plug. Compare *batholith* and *boss.* The word is used in the Saxon tin mines for floor or story, where igneous masses impregnated with tin-stone were mined in horizontal slices.

**Stratigraphy.** That branch of geology which treats of the arrangement and succession of strata; the study of the chronological order of succession in rock masses, and their present order of superposition and mutual relations. "There are three principal tests by which we determine the age of a given set of strata: first, superposition; secondly, mineral character; and, thirdly, organic remains. Some aid can be gained from a fourth kind of proof, namely, the fact of one deposit including in it fragments of a pre-existing rock, by which the relative ages of the two may, even in the absence of all other evidence, be determined." *Lyell.*

**Stratum** (L., a layer). A layer or bed of rock.

**Strike.** The horizontal direction of an outcrop of tilted rocks; the direction of a horizontal line supposed to be drawn on the surface of a tilted stratum. It is a compass direction and is at right angles to the direction of dip.

**Structure.** The larger physical features of rocks, as distinguished from texture, which is applied to the smaller ones.

**Stylolite.** A small columnar body of the same composition as the surrounding rock.

**Subærial.** Formed at the earth's surface in open air, in contrast with *aerial* on the one hand, and *submarine* and *subaqueous,* and *subterranean,* on the other hand. "True coal is a subærial accumulation by vegetable

growth on soils wet and swampy—but not submerged." *Dawson.* Compare *Æolian. Eolian* refers to rocks and soils accumulated on dry land, or to consolidated dunes.

**Syenite** (Syene, an Egyptian locality, now Assuan, where a hornblende granite was formerly obtained for obelisks). A plutonic, sub-acidic, granitoid rock composed essentially of orthoclase and hornblende.

**Syncline** (Gr. *sun,* together, and *clino,* I bend). A trough-like fold of stratified rocks.

**Syngenetic.** Formed at the same time with the enclosing rock; contemporaneous; said of mineral veins and similar deposits; contrasted with *epigenetic,* or *metamorphic.*

**Tachylite** (Gr. *tachos,* swift, *luein,* dissolve). A basaltic glass.

**Talc** (Persian). A hydrous magnesian silicate, usually consisting of broad, flat, smooth laminæ, or plates, greasy to the touch, of a shining luster, translucent, and often transparent when in very thin plates, fibrous to compact, pearly, apple-green, white, or grayish-white, sometimes brownish, crystallizing in the orthorhombic or monoclinic system. Talc, when powdered, is used for making lubricators, toilet powders, etc., and in solid slabs, for hearthstones, firebacks, laundry-tubs, etc. Soapstone, or steatite, is composed of the mineral talc.

**Talc-schist.** A schistose rock consisting chiefly of talc and quartz. Talc is also prefixed to several other rock names.

**Talus** (L. *talus,* the heel). The collection of broken rocks and earth at the foot of a cliff or steep slope.

**Taste.** A few minerals, being readily soluble, give a distinct taste. The principal kinds of taste are *astringent, cooling, sour, bitter, saline,* and *alkaline.*

**Tectonic.** Term applied to rock structures and external forms resulting from the deformation of the earth's crust; as *tectonic* arches, or *tectonic* valleys.

**Tephrite** (Gr. *tephra,* ashes, and *lithos,* stone). A subbasic lava rich in soda.

**Terrestrial deposits.** Terrestrial shells are univalves. The most important genera among them are *helix, cyclastoma, pupa, clausilia,* and *bulimus,* all of which oc-

cur in the loess. See *Marine deposits* and *Freshwater deposits.*

**Till.** Unsorted glacial deposits, consisting of boulders, clay, and sand. Consolidated till is known as tillite.

**Torbanite.** See *hydro-carbons.*

**Touch or Feel.** This is described as *meager* (chalk, clay, etc.), *harsh, rough, smooth, unctuous,* and *greasy.*

**Tourmaline** (Ceylonese). A bisilicate of aluminium with various other elements crystallizing in the rhombohedral system, often in the form of three-, six-, or nine-sided prisms, with vitreous to resinous luster, and found commonly black to brownish, or bluish-black, but sometimes blue, green, red, or colorless.

**Trachyte** (Gr. *trachus,* rough, rugged). A sub-acidic lava, sometimes microporphyritic in texture, consisting essentially of orthoclase and biotite, or hornblende, or augite, one or more.

**Trap** (Sw. *trappar,* step). Field name for any dark, finely crystalline igneous rock, often showing columnar structure.

**Travertine.** Calcareous tufa.

**Tripoli.** Infusorial earth; pulverulent silica derived from the breaking down of cherty limestones; rottenstone: used as a polishing powder.

**Tuff.** The finer fragments ejected from the explosive eruptions of volcanoes. They may afterwards be water-sorted or cemented to form solid rock.

**Tufa** (It.). The cellular deposits of mineral springs, usually calcareous or siliceous.

**Unakite.** A peculiar granite consisting essentially of epidote (always secondary), pink felspar and quartz. Found in Unaka Mountains, between North Carolina and Tennessee. A corresponding aplite occurs in dikes near Chapel Hill.

**Unctuous** (L. *unctuous,* oily). Being greasy or soapy to the touch, as certain magnesian minerals.

**U-shaped.** Having the form of the letter U; applied to valleys resembling a broad U in cross profile, and usually the product of glacier erosion, as distinguished from V-valleys formed by running water.

**Vein.** Strictly speaking, mineral matter which has been deposited in fissures in rocks from a solution in

water. Vein is contrasted with dike, which chills in a fissure from a fused condition.

**Veinstone.** The nonmetalliferous mineral or rock material which accompanies the ores in a vein, as quartz, calcite, barite, fluorite, etc.; veinstuff. See *Gangue.*

**Volcanic.** A term applied to surface flows of rock, as distinguished from plutonics or intrusives.

**Volcano** (It. *volcano,* a burning mountain). An opening in the earth's surface surrounded by an accumulation of ejected material forming a hill or mountain from which heated matter is or has been ejected at intervals or continuously. The materials ejected are chiefly vapor or water, lava, cinders, rock-fragments, and various gases. There is no true smoke and very little flame.

**Vugg** or **vugh.** A miner's name for a cavity in a lode,

**Willemite** (From Willem I., King of the Netherlands). A silicate of zinc, usually occurring massive and of a greenish-yellow color, also in reddish crystals (troostite) containing manganese.

frequently filled with crystals; called also *vogle.*

**Wollastonite** (William Wollaston, an English philosophical writer). A vitreous, white, translucent calcium silicate ($CaSiO_3$), crystallizing in the monoclinic system.

**Xenoliths.** Included masses of rock caught up in an igneous intrusion.

**Zeolites.** A series of hydrous aluminium silicates, with potassium, sodium, calcium, and sometimes barium.

**Zincite.** Native zinc oxide; a brittle, translucent mineral of an orange-red coor, a sub-adamantine luster, and a perfect basal cleavage. Hexagonal system.

**Zircon** (Arabic *zarkun,* vermilion). A mineral occurring in tetragonal crystals of adamantine luster, and yellowish to brownish, or reddish color; its hardness is sometimes greater than that of quartz; zirconium silicate. Gem varieties are *jargon* and *hyacinth.*

**Zonation** (Gr. *zone,* girdle). Arrangement in belts or zones, usually concentric, in stocks, bosses, laccolites, or sills, starting in an enclosed body of magma along the

walls where cooling begins. Here the iron ores and ferromagnesian minerals would be the first to crystallize; and, if the process were gradual, slow convection currents in the magma would bring fresh supplies of material to crystallize there until large amounts of these minerals would form. As the cooling proceeded the magma would grow less and less basic toward the center, giving a zoned arrangement to the whole mass. Sometimes salic outer zones are formed through the absorption by the magma of its containing walls; and a magma with large excess of acid minerals would form salic rocks in its outer zone, just as a bucket of seawater forms its border ice without salt, the remaining water being a brine of increasing strength until the eutectic point is reached, when both solidify together. The Chapel Hill mass shows zonation.

# ERRATA

**"Cinnibar,"** on page 13, should read *Cinnabar.*

**"Lignite"** paragraph, bottom of page 29, should appear on page 33 under L's.

"bioteme" in fourth line, next to last paragraph on page 45, should read *biotite.*

**"Stylolite"** (second paragraph from bottom of page 49), should read *styolite.*

Line beginning "frequently," midway page 52, should follow immediately after paragraph line beginning **"Vugg** or **vugh"** on same page.

# TABLE OF IGNEOUS ROCKS

| | ACID ROCKS 65-80% $SiO_2$ GRANITE FAMILY | SUB-ACID 60-65% $SiO_2$ SYENITE FAMILY | SUB-BASIC 55-60% $SiO_2$ DIORITE FAMILY | BASIC ROCKS 45-55% $SiO_2$ GABBRO FAMILY | ULTRA-BASIC Less than 45% $SiO_2$ PERIDOTITE FAMILY |
|---|---|---|---|---|---|
| VOLCANIC ..... | *Obsidian*<br>RHYOLITE<br>Felsite | *Pitchstone*<br>TRACHYTE | *Pitchstone*<br>ANDESITE | *Tachylite*<br>BASALT | ————<br>LIMBURGITE |
| Soda-rich | Keratophyre | Phonolite | Tephrite | Basanite | ———— |
| | Felsite | | Basalt | | |
| INTRUSIVE ..... | Quartz-porphyry<br>Aplite | Felsite-porphyry<br>(Anorthosite) | Porphyrite<br>Dacite | Basalt-porphyry<br>Diabase<br>Dolerite | Limburgite-porphyry<br>Augitophyre<br>Dunite |
| PLUTONIC ..... | Granite=quartz, acid felspar plus or minus mica | Syenite=acid felspar, hornblende plus or minus mica | Diorite=hornblende plus or minus basic felspar | Gabbro=pyroxene, labradorite plus or minus olivine, magnetite, ilmenite | Peridotite=olivine, pyroxene, magnetite; no felspar |
| METAMORPHOSED . | Granitoid-gneiss, mica-schist, novaculite, igneous slate, etc. | | Hornblende-gneiss, hornblende-schist, talc-schist, chlorite-schist, serpentine, etc. | | |

# FORMATION OF SEDIMENTARIES FROM IGNEOUS ROCKS
## WEATHERING PROCESSES

| Original Rock | Constituent Minerals | Chemical Composition | Method of Removal | How Deposited |
|---|---|---|---|---|
| Granite | Quartz | Silica | Silica in suspension; also taken in solution by organic acids | As sand; by action of organisms |
| | Acid felspar | Silicate of Alumina | Silicate of Alumina in suspension | Clay |
| | | Silicate of Potash | Carbonate of Potash in solution | In kelp; in all plants |
| | | Silicate of Soda | Carbonate of Soda in solution | In barilla; in most shore plants |
| | White mica | Silicate of Alumina<br>Silicate of Potash | As flakes of mica in suspension | Mica flakes |
| | Black mica | Silicate of Alumina<br>Silicate of Magnesia<br>Silicate of Iron | As flakes of secondary decomposition products<br>Iron in solution | Great variety of flaked materials<br>By plant action; as ferric oxide |
| Gabbro | Basic felspar | Silicate of Alumina | Clay in suspension | Clay |
| | | Silicate of Lime | Secondary silica in suspension; | Sand; limestone of both plant (*algae*) and animal origin; |
| | | Silicate of Soda | bicarbonates of lime and soda in solution | soda in salt deposits |
| | Ferromagnesian minerals | Silicate of Alumina | Clay in suspension | Clay |
| | | Silicate of Magnesia | Secondary silica in suspension; | Sand; limestone, dolomite, iron |
| | | Silicate of Iron | bicarbonates of lime, magnesia, and iron in solution | ore, formed chemically, mechanically, and by organisms |
| | | Silicate of Lime | | |

Bacteria play an important part in the decomposition of rocks. Note also alternations of heat and cold and action of frost.

# TABLE OF FRAGMENTAL ROCKS

| | MECHANICALLY FORMED | | |
|---|---|---|---|
| PHYSICAL STATE | CONGLOMERATE GROUP | SANDSTONE GROUP | MUDSTONE GROUP |
| LOOSE MATERIAL | Gravel, pebbles, bowlder clay, (volcanic breccia, arkose) | Sand, (volcanic sand, arkose) | Mud, rock-flour, clay, (volcanic dust) |
| LOOSELY CONSOLIDATED | Loose Conglomerate | Sand-Rock | Soft Pelite |
| COMPACTLY CONSOLIDATED | Conglomerate (breccia) | Sandstone | Shale |
| SLIGHTLY METAMORPHOSED | Metamorphic Conglomerate | Indurated Sandstone | Slate, Argillite |
| METAMORPHOSED | Lenticular Gneiss (Augen Gneiss) | Quartzite | Porcellanite, Novaculite, Phyllite |
| HIGHLY METAMORPHOSED | Crystalline Schists and Gneisses | | |
| RECOMPOSED | "Recomposed" granite, syenite, gabbro, serpentine, etc. | | |

# TABLE OF FRAGMENTAL ROCKS

| | ORGANICALLY AND CHEMICALLY FORMED | | |
|---|---|---|---|
| PHYSICAL STATE | IRON ORE GROUP | COAL GROUP | LIMESTONE GROUP |
| LOOSE MATERIAL | Iron sands, peroxides, coloring in soil, etc. | Swamp Muck | Shell-sand, coral-sand, etc. |
| LOOSELY CONSOLIDATED | Bog Iron | Peat | Coquina |
| COMPACTLY CONSOLIDATED | Limonite | Lignite | Fossiliferous Limestone |
| SLIGHTLY METAMORPHOSED | Hematite | Bituminous Coal | Limestone |
| METAMORPHOSED | Magnetite | Anthracite | Marble |
| HIGHLY METAMORPHOSED | Native Iron (Meteorite) | Graphite | Sparry Limestone, Ophicalcite |
| RECOMPOSED | Ferruginous, carbonaceous, and calcareous minerals, often in lenses or bands, in crystalline and igneous rocks. | | |

# TABLE OF METAMORPHIC ROCKS

| FROM SEDIMENTARY ROCKS | | | FROM IGNEOUS ROCKS | |
|---|---|---|---|---|
| KINDS | CONTACT | REGIONAL | GNEISSES | SCHISTS, ETC. |
| CONGLOMERATES | Metamorphic conglomerate<br>Lenticular-gneiss | Lenticular-gneiss<br>Granitic-gneiss | Granite-gneiss (gneiss proper) | Phyllite; quartz-schist, mica-schist, with garnet, staurolite, etc. |
| SANDSTONES | Indurated sandstone<br>Quartzite | Quartzite<br>Quartz-schist | Syenite-gneiss | |
| SHALES | Spotted slate<br>Spotted schist<br>Andalusite schist | Various slates gray-wackes, phyllites, horn-fels, schists | Diorite-gneiss | Amphibolite; horn-blende-schist, often with garnet, epidote schist, etc. |
| LIMESTONES | Calcareous shales and schists, with garnet, diopside, vesuvianite, epidote, wollas-tonite, scapolite, various ores | Marbles, ophicalcite, ser-pentine, often with chro-mite, garnet, etc. | Gabbro-gneiss | Chlorite-schist, talc-schist, etc. |
| | | | Pyroxenite-gneiss | Serpentine, often with chromite, garnet |
| COALS | Natural coke<br>**Anthracite** | Anthracite<br>**Graphite** | **Peridotite-gneiss** | Soapstone or steatite<br>Ophicalcite |

**Augen-gneiss has lenticular lumps, commonly felspar, though sometimes flattened quartz pebbles, in a schistose matrix, and is usually meta-igneous.**

# GENERAL TABLE OF GEOLOGIC TIME DIVISIONS

- **Cenozoic**
  - Quaternary
    - Present
    - Pleistocene
  - Tertiary
    - Pliocene
    - Miocene
    - Oligocene
    - Eocene
- Transition
- **Mesozoic**
  - Cretaceous (Upper Cretaceous)
  - Comanchean, or Shastan (Lower Cretaceous)
  - Jurassic
  - Triassic
- **Paleozoic**
  - Permian
  - Pennsylvanian (Coal Measure)
    *Wide-spread unconformity*
  - Mississippian (Subcarboniferous)
  - Devonian
  - Silurian
    *Wide-spread unconformity*
  - Ordovician
  - Cambrian
    *Great unconformity*
- **Proterozoic**
  - Keweenawan
    *Unconformity*
  - Upper Huronian (Animikean)
    *Unconformity*
  - Middle Huronian
    *Unconformity*
  - Lower Huronian
    *Great unconformity*
- **Archeozoic**
  - Archean Complex
    - Great Granitoid Series (Intrusive in the main; Laurentian)
    - Great Schist Series (Mona, Kitchi, Keewatin, Quinnisseè; Lower Huronian of some authors)